NEW ORDNANCE MATERIAL.*

Official Report to the U. S. War Department.

BY WM. H. BIXBY, CAPT. OF ENG'S., U. S. ARMY.

(*Continued from page 356.*)

New Forms of Projectiles.

New Palliser Ribbed and Jacketted Chilled-Iron Projectiles.—During the writer's visit to Shoeburyness on the 6th June 1882, experiments were being made with a new Palliser ribbed-and-jacketted chilled-iron solid shot for 3-inch guns. (See Plate 12.)

This shot had a chilled-iron ribbed-head of 4.47 inches length, of 2.985 inches maximum diameter, and with an ogival point of 2.5 diameters or 7.45 inches radius. The tail of this shot was composed of gray iron; and it carried two steel jackets, the diameter of the outer jacket being less than the maximum diameter of the head of the projectile at the ribs. In the shots tested on the 6th June, the ribs were six in number.

It was expected by the advocates of this new shot that the sharp conical point would give greater penetration and better perforation than other more obtuse points; that the use of ribs would practically reduce the diameter of the shot and thus the area of resistance; that the ribs would stop the rotation of the projectile, and guide the projectile as it passed through the plate and thus lessen the friction; that the jackets would enter readily into the large hole made by the head of the projectile, and would then lodge in the hole, allowing the tail of the shot to slide out from within the jacket with little or no friction, and without necessarily touching the sides of the hole already made.

Three shots were fired at a 4-inch Wilson-Cammell steel-faced-wrought-iron plate of good quality. All three 3-inch shots passed completely through the plate; the first without breaking until it struck another iron-plated target in rear; the second and third breaking up on emerging from the rear of the plate. The ribs were in no case torn or broken from the projectiles' head.

The 4-inch steel-faced plate was so easily perforated by the new 3-inch chilled shots that doubts were immediately expressed by every one as to the good quality of the compound plate. The plate was tested two days afterwards, by the ordinary projectiles and found to be of the usual strength.

The trials were regarded as a success for the new projectile, and as confirming the ideas of its inventors.

The following history of this shot and its trials, is extracted from an article by Capt. Orde-Browne, in the London *Engineer* of 9th June, 1882.

This shot was one of the last designs of the late Sir W. Palliser. The original Palliser chilled shot depended for success on the softness of the armor it penetrated. Wrought-iron had been introduced universally in some form. The Palliser shot first proposed had two advantages over the projectile previously employed: First, it was of hard, rigid, though brittle, material; secondly, its point was sharp, being, in fact, a considerable sharper ogival than those finally adopted in the service. The hardness enabled the projectile to stand up to its work. The sharp point told in two ways; first, it enables the shot to penetrate far enough to get considerable support from the surrounding armor before receiving the full shock of resistance; second, since perforated armor yields by tearing open at the back, a sharp point gets close to the tearing spot and so acts immediately and locally. From the above it may be seen how admirably a rigid shot with a sharp point acts on soft armor. On the other hand, the introduction of steel plates calls for a tenacity which chilled-iron does not possess, against outward yielding. Hence the failure of chilled shot against steel, although comparing well with the best steel shot against soft iron. The Surveyor-General of Ordnance in 1880 invited Sir William Palliser to design a special form of chilled projectile for hard armor. Sir William then made a shot (Fig. 5) with two peculiarities: First, it had longitudinal ribs on its head, which he hoped might assist in breaking up the steel face of the plate; experience having shown what a great matter it is to injure the continuity of any resisting steel surface and so attack it, as it were, locally and unevenly. Secondly, it was supported by a band of wrought-iron or steel round the body *B*, so as to hold together on the shock of impact.

The shot in Fig. 1 embodies one or two further improvements, due either we presume to Sir William or his brother, Captain Edward Palliser. It may be seen that there are two steel jackets; the inner one simply holds on to the body of the projectile, which here is of decreased size, and cylindrical; the outer jacket holds on to the inner one's conical exterior; the head between the ribs is of decreased diameter, corresponding to that of the inner jacket. Consequently it is hoped that the shot may enter the target in a hole of the decreased size, experiencing a corresponding smaller amount of resistance, the exterior jacket stripping off and being left behind. This last advantage might exist in the case of steel-fronted armor, but hardly in the case of hard steel, which breaks up and cracks, and is not punched in a clean hole. It will be seen that the fact of an armor-piercing shot having decreased diameter given in this way, does not affect the diameter of other projectiles fired from the same gun, such as common shell whose internal capacity is a matter of importance.

Chilled iron shot would of course benefit by a jacket of this kind much more than those of softer metal. A steel shot often yields at the shoulders, as shown in Fig. 2, while a chilled shot shivers without setting up. Such action, as is seen in Fig. 2, would tear a steel jacket from the front edge instead of acting on it evenly all over.

We believe that Captain Palliser has also proposed to employ steel riband as an alternative arrangement for the jackets shown in Fig. 1. It may possess three advantages:—(1) It has the tangential strength of a continuous spiral; (2) the actual tensile strength of a steel riband is greater than of steel of large cross section, apart from the question of the spiral being unbroken by a cross seam; (3) it can be applied by being wound on at the desired tension without heat, which may interfere with the temper of the metal.

The design of the shot in Fig. 1 is to retain the interior jacket and hold together in penetration. If this enabled a shell to penetrate armor before bursting, of course an enormous advantage would be secured. In fact, this is the object aimed at in the best forged steel shell.

With regard to the decreased area of resistance, or decreased diameter of the shot, on which Captain Edward Palliser lays official stress, we would call attention to Fig. 4, the front view of the head, in which it may be seen that the annular space between the circles A and B is considerable. This represents the decreased space except that of the cuts made by the ribs, and these cuts are only continuations of cutting lines begun from the entrance of the projectile's point, and, as experience shows, easily made.

These forms of the projectiles were tried at Shoeburyness, 6th June, 1882. They were made for the 13-pounder gun, for which the ordnance chilled projectiles have a diameter of 2.982 inches. The ordinary chilled shot for a 13-pounder gun have been fired by the sub-committee at wrought-iron plates of different thicknesses, proportioned to the charge and velocity of the shot. According to Col. Inglis the 13-pounder shot with a velocity of 1,550 feet would be a match for about 4.6 inches of wrought-iron unbacked. Taking 9.5 inches of good compound armor as equivalent to 12 inches of wrought-iron, a compound plate of 3.66 inches would be a match for a 13-pounder shot for a single round. For the plate to be fired at repeatedly, it would need perhaps four inches but on the above data, that, we think, ought to be more than a match for single rounds of the service shot. If the shot, however, were found to show extraordinary powers, a 4.5-inch plate might be advisable, especially as it will be seen in the description that the diameter of the new projectile is slightly decreased, being 2.585 ins. instead of 2.985 in.; 4 inches ought however to show any superiority well, although not to measure the amount of it if very marked. Captain Edward Palliser wished to get a 4.5-inch plate, we believe but had to content himself at the time with a 4-inch compound steel-faced plate supplied by Messrs. Cammell. The firing took

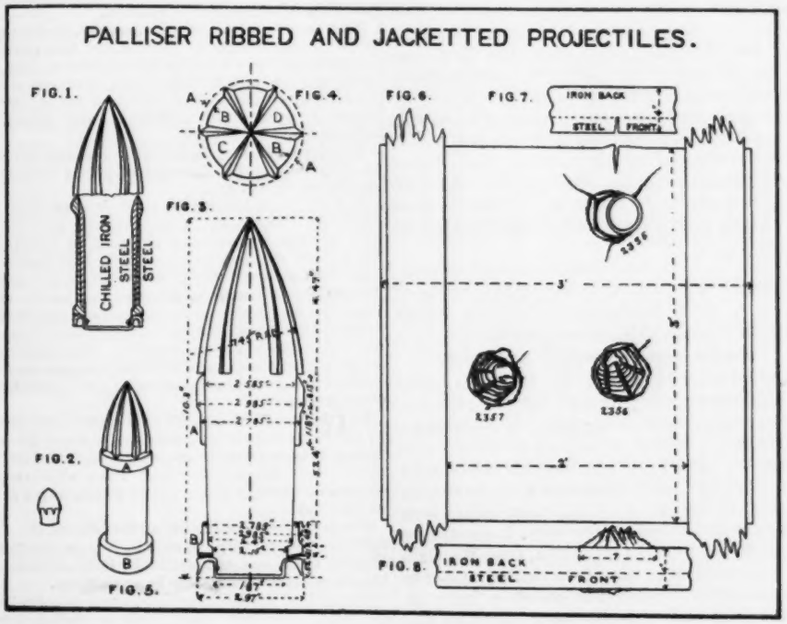

PLATE 12.

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place with a charge of 3.25 pounds, giving a velocity of about 1,550 feet, the weight of the shot being about 13 pounds. The point to which the committee specially directed their attention was the action of the ribs, having made some experiments already with some steel-jacketed chilled projectiles which had been suggested before now. We believe that Col. Nicholson, R. A., wrote a proposal for the the trial of wrought-iron coiled jackets in 1875. Nothing was carried out however until comparatively recently.

The plate was 3 feet square; it was set up and held firmly by timbers, as shown. The first round fired at it was No. 2,355, which struck a point 5 inches from the top edge and 13 inches from the proper left edge. The projectile was that with a double jacket, shown in Fig. 1. The result was very remarkable. The entire body of the shot passed through the compound plate, striking, indenting, and breaking itself against an old iron-plated target behind. The outer coat tore open and became detached, and the inner coat was left standing at the mouth of the hole—see Fig. 6 herewith. The shot struck a rather weak place, because it was too near the edge, as is seen in the crack of the edge of the plate at the top, which, however, at the time only bent, and did not actually crack until after the subsequent rounds had been fired—Figs. 6 and 7. The effect is remarkable in more than one way. Round the edge of the steel jacket in the plate may be seen the cuts in the plate effected by the hits of the projectile. It will be seen that the plate is cracked in four places at least, Fig. 7 herewith shows the crack through the steel face, and Fig. 8 shows the character of tear or opening in the back.

The second round was fired with a projectile differing from the first in having only a single steel jacket on it. In order as far as possible to prevent the shot being broken up by the face of the old armor plate behind, the bracket of an old gun carriage, 6 inches thick, was pushed in behind the part of the plate aimed at. The shot struck a spot 12 inches from the proper left edge, and 17.5 inches from the bottom, vide No. 2,356 on Fig. 6. The jacket flew to pieces on impact, the projectile passed entirely through the plate, the point entering to a depth of about 1.25 inches in the old target in rear, and the mass of the body remaining broken in two or three pieces in the wood bracket pushed behind the front plate. The third round was fired with the same charge and velocity as the others. The projectile differed from them in having only a short steel ring to hold it together—vide Fig. 3—being, in fact, the projectile actually designed by Sir William, the two others having been modified, and perhaps improved, by Captain Edward Palliser. This shot passed entirely through, like its predecessors, but it broke up into much smaller pieces, although wood had been placed behind the plate to receive it.

The character and the holes and appearance of the plates were most remarkable. This may in a measure be seen in Fig. 6 herewith. Each hole showed six grooves sharply and cleanly cut through the plate by the ribs of shot, and farther, the hole seemed to be so far misshapen as to look hexagonal. The ribs remained almost unbroken on the projectiles, although the heads were scored and polished by the violent friction. At first sight the plate looked as if it was very soft; on closer examination the scaling and burring round the holes at the face did not look like very soft steel. Then the plate continued "talking," and cracks continued to develop until after the Committee left the ground; this, at all events, was fully characteristic of steel. Eventually there were three radial cracks at 2,355, as well as one at the edge, vide Figs. 6 and 7, and one radial crack at each of the other holes. The openings at the back looked like good iron, fine and perhaps slightly hard—see Fig. 8. There was every appearance of the ribs having assisted in a remarkable way to open the plate and help the passage of the shot; and undoubtedly there was evidence of the steel jackets having held the projectiles very well together, the shot having certainly kept much better up to its work in the case of the longer and more complete jackets than in the case of No. 2,357. No doubt there is some advantage in the sharp points which these shots have—viz., an ogival of 2.5 diameters radius—in direct impact; but this is an advantage which only tells much when the shot penetrates, and it remains to be seen whether the ordinary chilled shot will penetrate well enough to be capable of benefitting by such a point if they had it. The metal of the projectiles appeared to be fine and good. The heads were well chilled and the bodies mottled. We believe it is contemplated to chill the shot throughout, and we believe rightly; because any bulging, as before stated, tends to tear the steel jackets from front to rear instead of pressing evenly on it, as we think a shot would do that did not set up, however much it split.

It was obviously most desirable to fire an ordinary chilled projectile for comparison, but unfortunately it was found all those supplied for the Sub-Committee on Plates and Projectiles had gone back to Woolwich.

On the 8th of June, an ordinary chilled shot was fired at the plate. Its velocity was 1,600 feet per second. It broke up on the face of the target, which was moderately bulged in the rear.

Altogether, Captain Palliser must be congratulated on the very remarkable success of his shot. Both bands and ribs have apparently done excellently (end of extract).

Gruson New Chilled-Steel Projectiles.

While the writer was at Mr. Gruson's works in Magdeburg, Germany, in 1881, Mr. Gruson was experimenting in the hope of obtaining a satisfactory chilled or *surface-hardened steel* projectile, which should show a superiority over ordinary steel projectiles equal to that obtained in the past by the Gruson chilled iron shot over the ordinary iron shot. It should be remembered, in this connection, that Mr. Gruson was the first to introduce chilled cast-iron shot in Germany; and that his shot have always held a high esteem on account of the superior quality of their chilled iron.

In November 1881, one of the new chilled-steel projectiles was cut half through, and then entirely broken by hydraulic pressure so as to show the quality of the interior metal. A fortnight later some of these new projectiles were fired against iron plates without any deformation of the projectile and with satisfactory results as to penetration.

The results of these trials were regarded as sufficient to justify Mr. Gruson in making preparations for an extensive manufacture of these projectiles.

The cost of the chilled-steel projectiles is estimated at about twice that of chilled-iron projectiles.

TO BE CONTINUED.

American vs. English Practice.

New York, Nov. 30, 1885.

EDITOR ENGINEERING NEWS:—In your article of Nov. 7, headed "American vs. English Practice," and on Nov. 14, as to Railways in India, and elsewhere of late in your issues, there are statements made as to the superiority of American engineers and American practice over those of England, which I do not think are justified by the facts.

I presume you will allow that circumstances alter cases, and that comparisons can only be fairly made when the conditions are similar.

To compare the cost of works in an old and settled country, thickly populated, of comparatively small area, frequently recurring towns and villages which have to be accomodated, intersected in every direction with roads and canals which are not allowed to be crossed on the level, with the cost in a new country, where the conditions are almost reversed, is not reasonable.

Given the same requirements, and it is clearly impossible for a railway to be constructed in America as cheaply as it can be in England; with the exception of the land, which in England is enormously more expensive to procure than in America, and of the Parliamentary and preliminary expenses, which are practically unknown here, the cost of building a road, consists of materials and labor.

The same mechanics and workmen have built the roads in America as in England, because English, Irish, Scotch, Germans, etc., are the men who have done the actual work of construction in either country, and an experience of 40 years of practice in the construction of works, and employ of labor in both countries proves to me, that, if anything, less work is got out of the workman in America, than in England, while on the other hand his wages are about double, and consequently the cost per unit of work must be so much greater.

If a given line of country and topography, necessitates a given amount of earthwork, number of bridges, stations, etc., the cost of the work will be the same, whether it is engineered by an Englishman or American.

In England it is the practice to finish the road at once, as regards ballast, stations, etc., because capital is plentiful and rate of interest low, and the requirements of the Board of Trade, and the demands of the traveling public have to be satisfied.

The reverse is the rule in America, and may be, it is the proper course to pursue for the purpose of opening out a new country for occupation, but it has nothing to do with the question of engineering, and is merely one of expedieney. England has to start finished, America starts unfinished, and reconstructs afterwards.

Either system may be the most suitable for its respective country, but there is no basis for a comparison on engineering grounds.

In a paper read before the Institution of Civil Engineers by Messrs. C. D. and Francis Fox, Nov. 24, 1874 on "The Pennsylvania Railroad," it is stated that up to 1855 the Pennsylvania R. R. had cost for the main line about $56,000 per mile of single line, and that from 1855 to 1873, there had been expended out of revenue, upon permanent improvements and works of construction, including the substitution of iron for wood in bridges and of steel for iron rails, about $33,000 per mile, making the cost at that time $89,000 per mile of single line, $189,000 per mile of double line excluding branches.

Now this constant expenditure upon improvements by the Pennsylvania road must be for some good purpose as it is only fair to the engineers and officers of the road to assume that they know what they are about, and I presume you will be willing to grant such an assumption.

But notwithstanding all this expenditure, the Pennsylvania road, exceptional as it is, is no better than the English roads, and as regards the item of level crossings, there is no comparison between them.

The cost of the English roads, which practically begin where the Pennsylvania road is ending, average $180,000 per mile.

So much for the home work; now let us see how the case stands for the foreign.

English capital and English engineers have built railways in Ireland, India and the continent of Europe, South America, Canada, Australia, New Zealand, etc.

In these countries the conditions of things more closely resemble those of America, and consequently a fairer comparison can be made.

By Poor's Manual for 1883, the average cost per mile of single line here in America, is given as $61,342.

The average cost of Irish lines to 1856, mostly double, was $75,000 per mile, and subsequent single lines $30,000 to $35,000, all complete.

Hungarian lines	$26,500 to $36,000 per mile.
Argentine Republic	$35,000 " "
Queensland	$30,000 to $45,000 " "
New Zealand	$32 500
South Australia	$25,000 to $30,000.

All these roads are fully ballasted, and in every respect first-class roads, with stations, etc, complete, practically as good as the best of American roads.

It would seem then that the "slow," "antiquated," "crude," and "old fogy" English engineer, when not tramelled by the conditions of the old country, can do as well, if not better, than the so much vaunted American engineer. And I do not see why he should not; he is certainly as well educated, and trained, he is as active and energetic and can get as much work out of himself and his men, as any other man.

You wonder why Russia does not employ American contractors to build their road to Herat, because by so doing they would secure a progress of over two miles a day.

Mr. D. Ker, in his interesting letter of November 22d, to the N. Y. *Times*, says the railway, constructed by English engineers through Beloochistan, averaged two miles per day; so it does not seem that they are so very slow after all. Yours, GEO. K. RADFORD,

M. Inst. C. E.

No. 10.—SIDELING HILL TUNNEL.—3rd Division.

Continued from page 339.

1. Sideling Hill, West.

2. Variable — Gray Sandstone and Shale in alternate and very short measures.
3. 57° west.
4. See sketch. Yardage 3.5 cubic yards per lineal foot.
5. Number and position generally as shown on sketch — depth of center cut holes 9 feet and of squaring up holes 8 feet.
6. Center cut 61 pounds Rackarock. Squaring up 54 pounds 40% dynamite.
7. 7.3 feet.
8. 22 hours—(*a*) 14 hours 45 minutes, (*b*) 2 hours 50 minutes, (c) 4 hours 25 minutes.
9. No top or side enlargement during period of observation.

9½. No.

10. None during period of observation.
11. Advance heading 8.36 pounds Rackarock and 7.4 pounds 40% dynamite per lineal foot. Bench 40% dynamite per lineal foot.
12. Force per lineal foot of tunnel = 10.7 cubic yards.

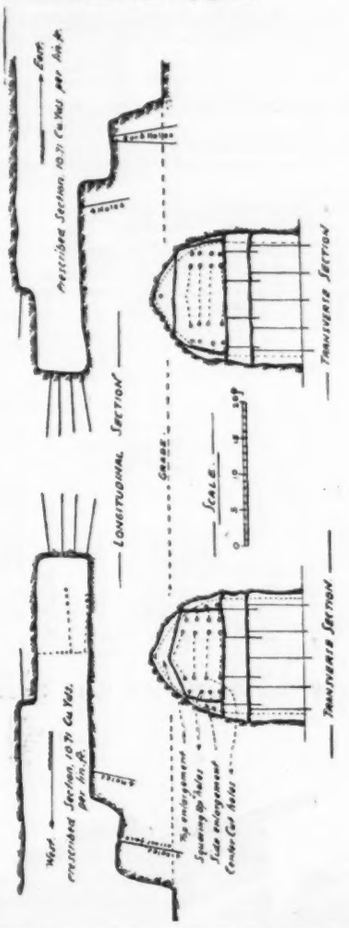
	HEADING.	BENCH.
Foremen	0.35 days	0.21 days
Power Drillers	0.71 "	0.38 "
Helpers	0.71 "	0.32 "
Muckers	0.35 "	2.02 "
Trimmers	0.71 "	0.21 "
Nippers	0.18 "	0.11 "

13. See sketch. Columns in heading about 5 feet from face.
14. All worked in one lift. All muck loaded from grade into car bodies, which are lifted and placed on trucks with derrick.
15. Yardage 8.3 cubic yards per lineal foot. Time 2 hours 20 minutes per lineal foot. Holes 13 feet per lineal foot. Explosives 12 pounds 40% dynamite per lineal foot.
16. None used.
17. Difficulty in getting good labor.

Force (per 11 hour shift) not accounted for above.

Superintendents	1.00	Drivers	3.00
Engineers	1.00	Blacksmiths	1.00
Firemen	1.00	Helpers	1 00
Horses	3.00	Dumpmen	1.00

The above derived from notes taken from June 4th to June 18, 1885.



1. Sideling Hill, East.

2. Gray Sandstone on South side and Slate on North side.
3. 13° East. Irregular formation.
4. See sketch. Yardage 6.5 cubic yards per lineal foot.
5. Number and position generally as shown on sketch. Depth of center cut holes 7.7 feet. Squaring up holes 7.7 feet.
6. Center cut 34 pounds rackarock. Squaring up 38 pounds rackarock.
7. 6 feet.
8. 26 hours 35 minutes (*a*) 20 hours (*b*) 2 hours 20 minutes (*c*) 4 hours 15 minutes.
9. For number and position see sketch. Side enlargement holes 3.9 feet per lineal foot of tunnel. Yardage 0.5 cubic yards per lineal foot.

9½. No. Enlargement made by heading force at odd times.

10. For side enlargement 3.7 pounds rackarock per lineal foot tunnel.
11. Advance heading 24 pounds rackarock per lineal foot. Side enlargement 4.5 pounds per lineal foot (rackarock). Bench 9.6 pounds rackarock per lineal foot.
12. Force per lineal foot of tunnel = 16.2 cubic yards.

	HEADING.	BENCH.
Foremen	0.44 days	0.36 days
Power Drillers	1.76 "	0.36 "
Helpers	1.76 "	0.36 "
Muckers	2.44 "	5.10 "
Trimmers		
Nippers	0.22 "	0.18 "

13. See sketch. Columns in heading 4 feet from face.
14. All worked in one lift. All muck is loaded from grade into car bodies which are lifted and placed on trucks with derrick.
15. Yardage 10.5 cubic yards per lineal foot. Time 3 hours 35 minutes per lineal foot. Holes 10.5 feet per lineal foot. Explosives 9.6 pounds dynamite (40%) per lineal foot.
16. None used at present, occasionally as shown by dotted lines in sketch.
17. Nature of rock, or difficulty in getting good labor.

Force (per 11 hour shift) not accounted for above.

Superintendent	1.00	Drivers	1.00
Engineer	1.00	Blacksmiths	1.50
Firemen	1.00	Helpers	1.50
Horses	2.00	Dumpmen	1.00

The above derived from notes taken from June 6th to 18th 1885.

No. 11.—RAYS HILL TUNNEL.—3rd Division.

1. Ray's Hill, West.

2. Variable—red sandstone, Catskill formation and a gray sandstone hard and fine grained.
3. East—varying from 40° at portal to 80° at heading.
4. About 7 feet × 14 feet on an average; yardage, 2.5 cubic yards per lineal foot.
5. Number and position generally as shown on sketch. Average depth 3.5 feet.
6. 8 pounds per round—40 to 50 % dynamite.
7. One cut consists of 3 to 4 rounds. Average 2.5 feet per cut.
8. 2.5 to 3.0 in 11 hours. (*a*) 9 hours (*b*) 1 hour 45 minutes (*c*) 15 minutes.
9. Sides and heading carried together.

9½. Yes.

10. Drilling, being done by hand; have no side holes.
11. Advance heading, 5 pounds 50 % dynamite and 16 pounds 40 % dynamite per lineal foot.
Bottom 5 pounds 50 % dynamite and 8 pounds 40 % dynamite per lineal foot of bench.
12. Force per lineal foot of tunnel.

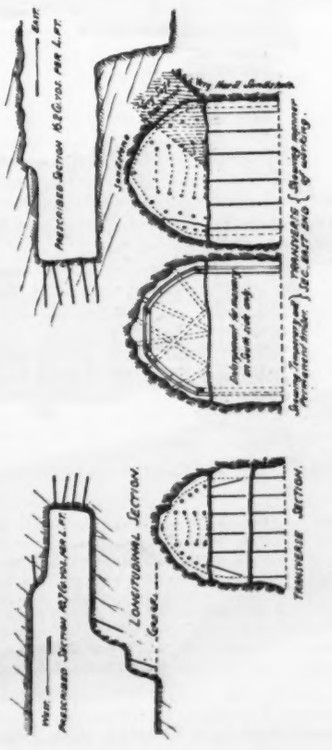
	Heading.	Bench.
Foremen	0.38 days	0.38 days.
Drillers	3.10 "	2.31 "
Muckers	1.16 "	1.92 "
Trimmers	1.54 "	— "
Nippers	0.77 "	0.77 "

13. No machines used.
14. See sketch. A small portion of material from upper lift of bench and from heading is wheeled on gang planks to a portable platform and dumped directly into cars, at grade—balance loaded from grade.
15. Yardage 8.3 cubic yards per lineal foot. Time 5.2 hours per lineal foot. Holes 19 feet per lineal foot. Explosives 5 pounds 50 % and 8 pounds 40 % dynamite per lineal foot.
16. None used.
17. Considerable difficulty is experienced in blasting on account of the variable material—Excavating Gothic roof.

Force (per 10 hour shift) not accounted for above.

Superintendent	0.50
Blacksmith	1.00
Helper	1.00
Cars	4.00
Mules	3.00
Drivers	2.00

The above is derived from notes taken from April 1st to May 30, 1885.



TO BE CONTINUED

1. Ray's Hill, East.

2. Gray sandstone. Hard and fine grained; occasionally very frequent dry seams are met with.
3. East—varying from 20° degrees at portal to 80° at heading.
4. See sketch—7 feet × 14 feet. Yardage 2.5 feet per lineal foot.
5. Number and position generally as shown in sketch. Average depth 16 feet.
6. Center cut 96 pounds 60 % dynamite; do not always use 60 % dynamite alone; sometimes use 75 % and 50 % dynamite.
7. About 7 feet.
8. 30 hours (*a*) 25 hours 45 minutes (*b*) 1 hour 15 minutes for center cut, 30 minutes side round (*c*) 2 hours 3 minutes.
9. For number and position see sketch. Depth 8 feet.

9½. Not always, depends on circumstances.

10. 60 pounds 60 % dynamite.
11. Advance heading 23.4 pounds 60 % dynamite per lineal foot of tunnel. Top and side enlargement 1.6 pounds dynamite per lineal foot of tunnel. Bench 15.5 pounds per lineal foot (60 % dynamite).
12. Force per lineal foot of tunnel.

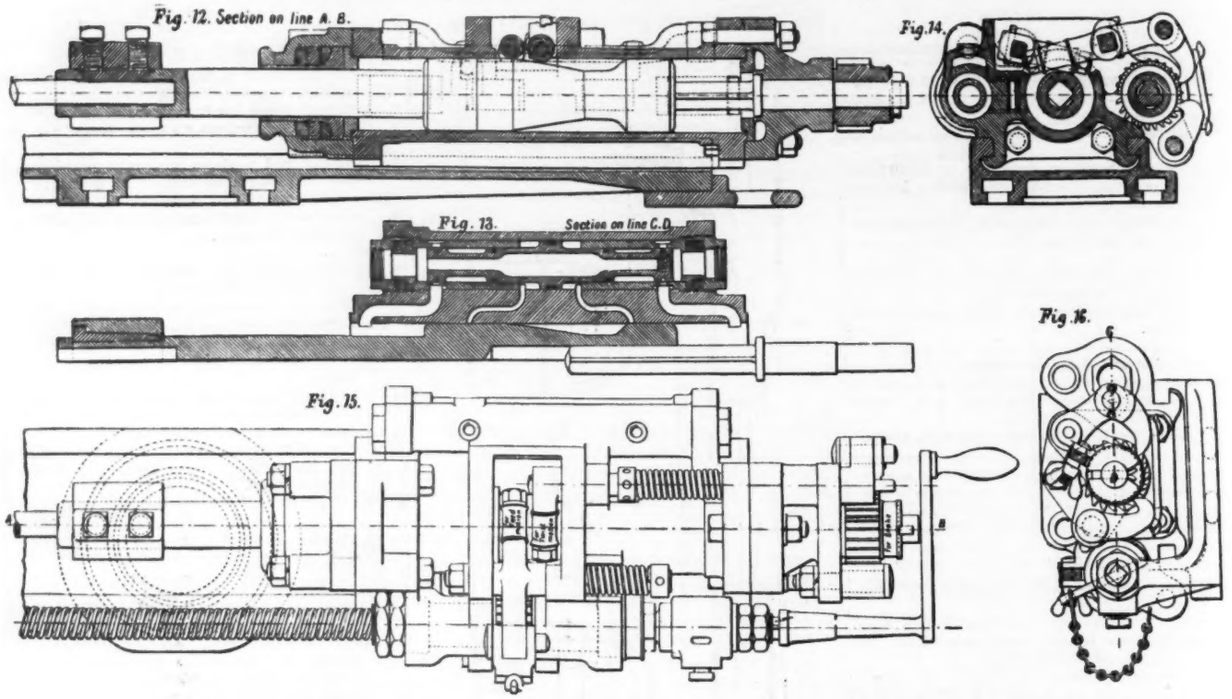
	Heading.	Bench.
Foremen	0.41 days	0.41 days.
Power Drillers	1 11 "	0.95 "
Helpers	1.11 "	0.95 "
Muckers	1.34 "	4.00 "
Trimmers	0.20 "	— "
Nippers	0.41 "	0.40 "

13. See sketch. Columns in heading 4 feet from face.
14. See sketch. 4 holes in offset breast down to grade, together with 4 holes or lifters at and parallel to grade 8 feet deep. The muck from the heading is wheeled over gang planks to a portable platform and dumped directly into cars at grade; balance loaded from grade.
15. Yardage 8.2 cubic yards per lineal foot. Time 5 hours per lineal foot. Holes 1.47 feet per lineal foot. Explosives.
16. None used.
17. 1st. Blasting—The rounds frequently fail to do their work properly. 2nd. The drills get fast in oblique seams thereby causing much delay. 3rd. Gothic roof.

Force (per 10 hour shift) not accounted for above.

Superintendents	0.50	Drivers	3.00
Engineers	0.40	Blacksmiths	1.00
Firemen	0.40	Helpers	1.00
Mules	3.00	Dumpmen	2.00

The above is derived from notes taken during month of May, 1885.



The Beaumont Drill, as made by Messrs. Jos. Foster & Sons, Preston, England.—(*See Page* 373.)

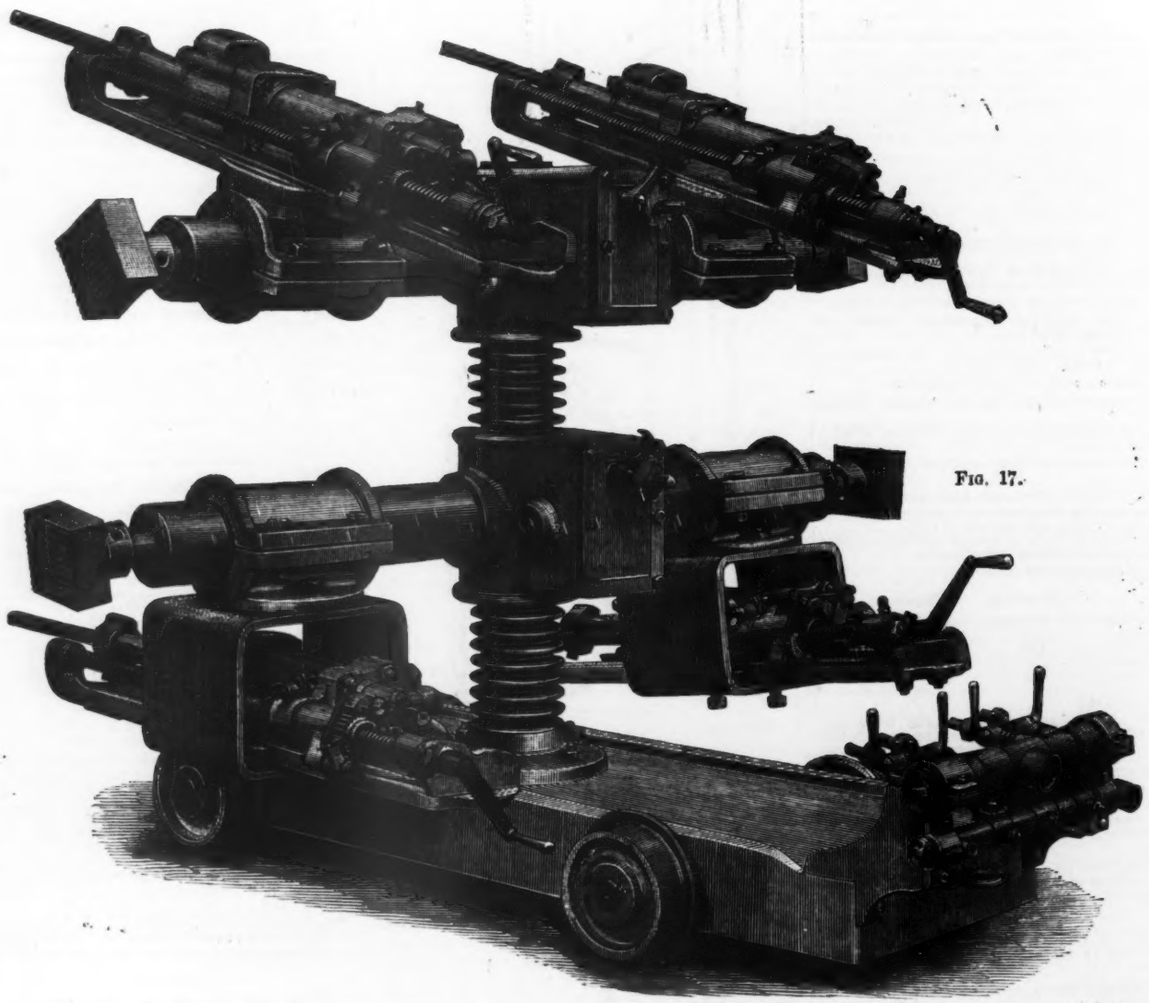
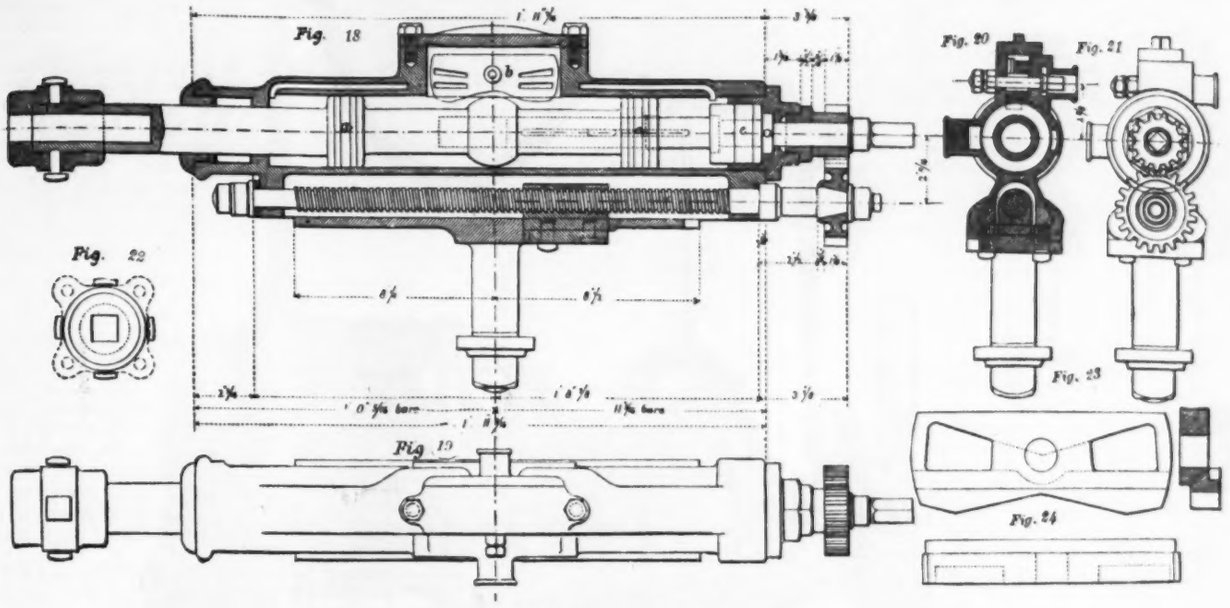


FIG. 17.

The Beaumont Drill on a Carriage.—(*See Page* 373.)



The Barrow Rock Drill.

English Rock-Drills at the Inventions Exhibition.

From *Engineering* of November 6, we reproduce several varieties of rock drills exhibited at the Inventions Exhibition in London. The descriptive matter is also from our contemporary.

Messrs. Joseph Foster and Sons, of Bowlane Iron Works, Preston, make a good exhibit of their percussive rock drills, carriages for same, and various details. The figures illustrate their system thoroughly. From these drawings it will be seen that the piston of the rod on which the drill is mounted, is actuated by a piston valve (Fig. 13). The stroke is very short, and the piston is made of the peculiar form shown, in order to drive the feed and twist movements of the drill. To effect this the cylinder is made with an opening at the top, and in this opening, in contact with the piston, lie the ends of two levers, which are attached to rods placed parallel to the axis of the drill, and surrounded by coiled springs, as shown. One of the levers commands two pawls working into a ratchet wheel on the end of the feeding screw, the other actuates a pawl gearing into a ratchet wheel on the end of the square spindle that enters the hollowed portion of the piston. On each stroke, when this device is in gear, the whole machine is advanced by the feeding screw, and the drill is twisted by the motion of the square spindle, but both can be thrown out of gear, and the machine can be fed forward by the handle on the end of the feed screw, which of course, takes its bearings on the fixed frame of the machine. Fig. 17 illustrates a group of four of Messrs. Foster and Sons' drills. They are carried on a heavy vertical standard with a circular rack, this standard being in the middle of a suitable wheeled carriage, on one end of which are conveniently placed the various connections for leading steam or compressed air to the drills. The installation illustrated shows two large boxes placed on the vertical standard, and capable of being raised or lowered by means of pinions working in the rack. From two opposite sides of these boxes tubular frames project, at each end of which are telescopic adjustments, with slope plates for locking the machine against the sides of the tunnel or heading. Long sleeves embrace the horizontal frames, and to these the frames of the drills are mounted in such a way that they can be turned round at any angle. By this means the work can be attacked in any direction or in any angle. Figs. 18 to 24 illustrate the "Barrow" rock drill, exhibited by the Barrow Rock Drill and Mining Company, of Saltash, Cornwall. It is a very simple machine, provided only with hand feed, that controls by gearing the twist of the piston rod. A box in the center of the long piston casting actuates, in the travel of the piston, a vertical oscillating valve that effects the distribution of the compressed air to each end of the cylinder. Simplicity appears to be one of the chief objects in this design, and the machine appears well adapted for its work.

The Aqueous Works and Diamond Rock-Boring Company, Limited, of London, exhibit a light portable rock-boring machine for prospecting for minerals, water, etc. It is capable of sinking holes from 2 inches to 5 inches in diameter, and to a depth of 400 feet. The screwed boring spindle, which is in front of the machine, is actuated by mitre gearing driven by a six horse-power engine, the speed of driving is 400 revolutions a minute. The pump shown on the left-hand side of the engraving is used to deliver a constant stream of water through the boring bar, the connection being made by a flexible hose. Suitable winding gear for raising or lowering the lining tubes, boring rods, etc., is also mounted on the same frame. The drill is automatic in its action, and the speed can be regulated by friction gearing. The front part of the carriage is arranged so that it can be swung clear of the drill to allow of the raising and lowering of the bore rods, etc. We believe that very excellent work has been done by this machine.

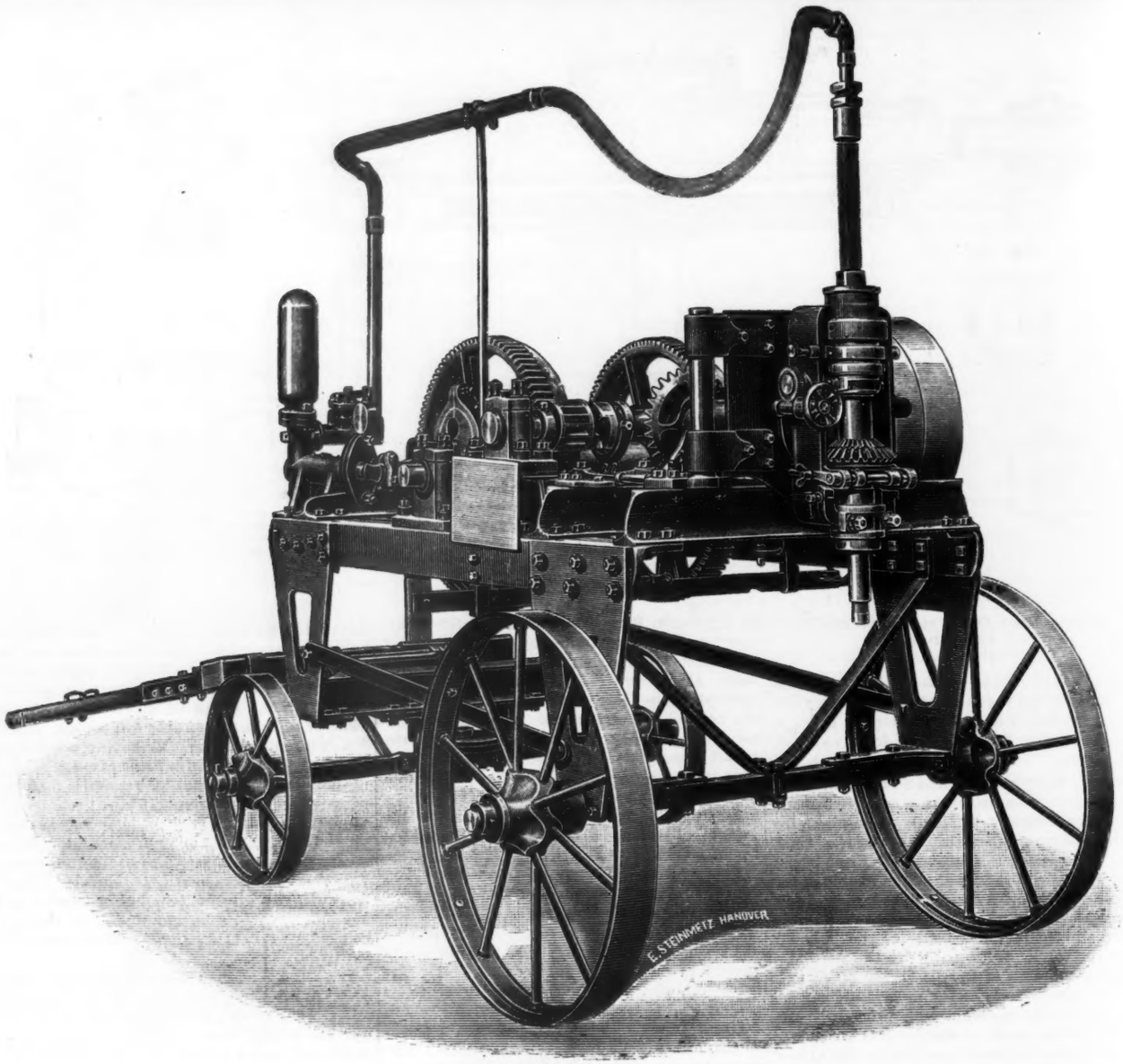
Iron Substructure for Railroad Bridges.

Recently a number of invited guests examined a number of iron bridges on the Cleveland and Marietta Railroad, the substructure of which was put up by the Iron Substructure Co., of Columbus, Ohio. The *Railway Review* has printed an illustrated description, from which we gather the following:

The method of construction consists in the use of cast-iron piles as a substitute for masonry, under the Gray-Abbott patent. This pile is an iron cylinder with four radiating flanges. The lower end of the pile is solid and pointed. The lower ends of the flanges are also beveled and sharpened, extending to the point of the pile. The upper end of the pile is a cylindrical socket, and over this there is fitted a cap, the upper portion of which is a flat plate with flanged edges for receiving the bridge beams. The form of the pile is such as to afford the greatest strength with a minimum of metal, and at the same time make it easy to drive. It can be driven through any kind of soil and even into sandstone, shale, etc., without breaking. In driving, a solid cylindrical piece of wood is fitted into the socket of the pile to receive the blows, and is removed when the pile is driven. In case great length of pile is needed, a very simple and secure system of splicing is adopted. In order to increase the bearing, plates are sometimes used a short distance beneath the surface. These have, however, been found unnecessary, and will not generally be employed, as the pile has sufficient bearing and is stiff enough without them.

The Cleveland and Marietta Railroad runs along Wills Creek and crosses it 18 times in 25 miles. The stream is sluggish, and at certain seasons brings down immense quantities of driftwood, which is prone to lodge against any obstruction and accumulate in an unpleasan manner. The bridge just above Byesville wa. built on wooden piles which obstructed the stream and was a constant source of trouble and expense. It being necessary to rebuild it this year the receiver of the road determined to avoid future trouble by using iron piles, leaving the channel of the stream entirely unobstructed and offering less chance than masonry for lodgment of driftwood at the shore ends. The bridge has been recently completed. It is 124 feet span, 14 feet roadway and 19 feet clear hight. The iron piles are 33 feet long, were driven by a 1900 pound steam hammer through 6 feet of clay and 18 feet of soft muck, and rest upon solid shale rock 38 feet below the rails. The cost was about one-half that of first-class masonry, which to all intents and purposes it equals. The piles were very rigid and the vibration under the passing of heavy trains at rapid speed was very slight. The superstructure of this bridge is a wooden Howe truss of noticeable superiority of material and workmanship. It was furnished by the Smith Bridge Co., of Toledo, Ohio.

A New Island in the Pacific.—SAN FRANCISCO, Dec. 2.—B. Greenebaum, United States Consul in Samoa, in a letter to the Merchants' Exchange of this city, says that an island never before reported has been thrown up out of the sea about 40 miles of the Tonga Islands bearing toward the Fiji Islands, in the track of California vessels. The island is two miles long and 250 feet high, and is in latitude 20° 28' south, longitude 175° 21' west.



Portable Prospecting Drill, made by the Aqueous Works and Diamond Drill Boring Co., London, England.—(*See Page* 373.)

CORRESPONDENCE.

Wabash, Ind., Water Works.

WABASH, Ind., Nov. 28th, 1885.

EDITOR ENGINEERING NEWS: Yours of 25th inst. at hand. In regard to Jesse W. Starr Jr.'s contract, I am happy to state that the gentleman stands all right here, and has not failed in a single particular. The City Ordinance providing for the construction of water-works was passed by the Common Council on the 20th day of September last. By the terms of this ordinance, the contractor, Jesse W. Starr, Jr., of Philadelphia, was to have sixty days' time from the date thereof, to perfect his contract and commence work. The limitation does not expire until the 28th of this month. The complaints indulged in by certain newspapers as to delay on the part of Mr. Starr are without any foundation. On Tuesday, November 18, 1885, Mr. Starr arrived in this city, deposited $2,000 in the Citizen's Bank, perfected his contract, and purchased ground upon which the stand pipe will be erected. Mr. Thomas Bridges, of this city, has the contract for the construction of the stand pipe. He will have the foundation completed this evening. The filtering galleries are to have a capacity of 4,000,000 of gallons, and the pumping power 3,000,000 of gallons of water every twenty four hours. There are to be twelve and one-half miles of distributing water mains of the following dimensions: 6,800 feet of 12-inch pipe, 3,930 feet of 10 inch inch pipe, 14,200 feet of 8-inch, 35,170 feet of 6-inch, and 5,900 of 4-inch, all to be laid not less than 5 feet below the surface of the ground, or treet grade. Work upon this branch of the plant will be commenced next spring. Mr. Starr is to receive $4,000 per year for twenty years, payments to be made semi-annually on the first days of January and July. I am the local engineer, and am now preparing a map of the city, showing the pipe distribution. If you require any further information let me know. I am at your service.

Very truly yours,
JAMES W. SHEA,

Tall Standpipes.

LAMPASAS, TEXAS, Nov. 27, 1885.

EDITOR ENGINEERING NEWS:—Is there any case on record of an iron standpipe for water-works use, being cased on the outside with brick or stone masonry with a view to stability?

It would seem to the writer that in a high standpipe —say 200 or 300 feet high—it would add much to the stability to have such a casing for say ⅓ of the height built around it. Starting from a base of proper width and narrowing towards the top, with light batter on the outside; such a casing of masonry with the interior face of same left a few inches clear of the standpipe to admit of being filled with sand so as to equalize the pressure and prevent rupture of bond in the masonry, would seem to have the effect of giving stability to the structure.

It is possible, however, that this may not be practically effective, owing to the oscillations of the upper portion in a high wind which would have a tendency to disrupt the masonry near the top.

An opinion from yourself, or from some of your numerous readers interested in this class of construction would be interesting.

The stability of high standpipes without guys, the theory of their resistance to wind pressure, etc., is a highly interesting subject upon which very little has been written.

ENGINEER.

[We are not aware of any such application of brick masonry casing to tall standpipes as suggested, and feel certain that the oscillation referred to would disrupt the masonry in such a case. To secure an artificial head of 300 feet we would suggest that a safer, and doubtless quite as economical a plan, would be to elevate a steel or iron tank either on an iron braced skeleton tower or upon brick or stone masonry. If a metal cylinder is to be used for the whole height without guys, diameter alone will give it stability; such a cylinder would doubtless store more water, but its contents would be delivered under very unequal pressures and the lower half would be of little practical value The brick casing suggested, if thick enough to add materially to the stiffness of the structure, would practically support the proposed tank, and the lower metal half, and the heaviest part of it, would be saved.

The subject however, is an interesting one and its discussion would be welcome reading to many of our readers. We trust that we may hear more of it from engineers.—ED. ENG. NEWS.]

Twenty-Four O'clock.

TARRYTOWN, N. Y. Dec. 7, 1885.

EDITOR ENGINEERING NEWS:—The plan of counting the hours of the day from one up twenty-four seems to possess considerable merit on the score of age. I saw a day or so ago a quotation from Burkardt's Diarium immediately to the point; he says, speaking of the sickness of Pope Alexander VI.:

"Le 12 (Août 1503) aprés vêpres, entre vingt et une et. vingt-deux heures, le pape a été atteint de la fiévre." "After vespers, [August] 12 [1503], between twenty-one and twenty-two o'clock, the pope was attacked by a fever."

This would indicate the use of this system in the early days of the XVIth century.

Yours. W.

To Determine a True Meridian.

Written for ENGINEERING NEWS.

BY I. O. BAKER, PROF. OF C. E., UNIVERSITY OF ILLINOIS.

In connection with the article on "*Local Attraction in Land Surveying*" in the NEWS of October 31st., the writer has received two requests for his opinion as to the best method of determining a true meridian, and as in the past he has occasionally received similar requests, he therefore ventures to offer the following, although an examination of the files of any engineering newspaper will doubtless show many similar articles.

POLARIS AND MIZAR METHOD.—For this time of year this is about the most convenient method, and is amply sufficient for compass work. The principle of the method is the same as that described in the text-books as the Alioth and Polaris Method. Mizar is the second star, counting from the fore end, in the handle of the Great Dipper; Alioth is the third one; Polaris is the pole star. When Polaris and Mizar are in a vertical line, they are also very nearly on a meridian. See Fig. 1.

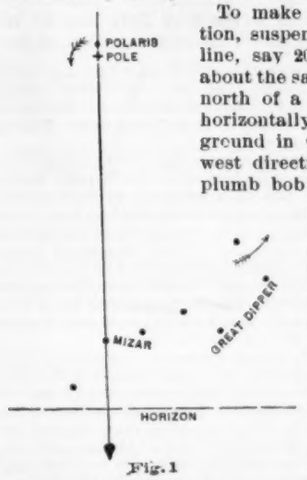


Fig. 1

To make the observation, suspend a plumb line, say 20 feet long, about the same distance north of a board fixed horizontally near the ground in an east and west direction; let the plumb bob swing in a pail of water to check the vibrations; hang a lantern overhead and behind to make the line visible. Watch and wait until Polaris and Mizar are exactly covered by the plumb line; see Fig. 1.; when the stars are in the same vertical plane, mark a point on the board in range with the stars and plumb line. On the first of January, 1886, this line will lie about 2.7 seconds west of the true meridian: the line will move *east* about 26″ per year for several years. The whole apparatus may be left undisturbed until morning, when the line can be permanently marked; or it may be marked at the time of observation by having an assistant hold a light, seen through a small aperature in a board, which is moved according to signals until it is in line with the plumb line and the point marked on the board.

On the 1st of January, Polaris and Mizar are in the same vertical about 6:30 p. m.; the time for any day before that can be found by subtracting four minutes for each day, and for any day after January 1st, add a like amount. In the summer and early fall these stars come into the required position at an inconvenient hour, and can not be used at all in the spring on account of coming in the desired position in daytime. At these times the same method may be applied in observing a different pair, Polaris and δ Cassiopeia. (See Fig. 2.)

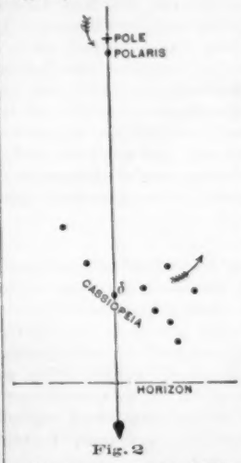


Fig. 2

The constellation Cassiopeia is on the opposite side of the pole from the Great Dipper; it is on the meridian under the pole about 6:30 June 1st, and four minutes earlier each day later. The relative position of the stars at the time of observation is shown in Fig. 2. The line determined by observing these stars June 1, 1886, will be within 1″ or 2′ of a true meridian and will move *west* about 25″ per year.

Neither of these pairs can be observed from June 1st to August 1st, and from the latter date until November 1st at inconvenient hours; at such times one of the following methods must be used:

(In passing, it may be well to caution the surveyor against following the text-books in the matter of the accuracy of the Polaris-Alioth method; it is sometimes stated that when Polaris and Alioth are in the same vertical, they are "very nearly in a meridian," and it is also stated more accurately that "Polaris is precisely on a meridian seventeen minutes after the two are in the same vertical." The facts are that the two stars are 12′ 29″ east of a true meridian January 1, 1886, and Polaris comes to a true meridian about twenty-eight minutes thereafter; these quantities increase from year to year.)

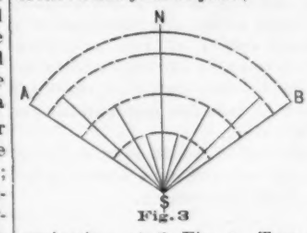


Fig. 3

METHOD BY EQUAL SHADOWS OF THE SUN: "On the south side of any level surface, erect an upright staff, shown in horizontal projection, at *S*, Fig. 3. Two or three hours before noon, mark the extremity, *A*, of its shadow. Describe an arc of a circle with *S*, the foot of the staff, for a center, and *SA*, the distance to the extremity of the shadow, for a radius. About as many hours after noon as it had been before noon when the first mark was made, watch for the moment when the end of the shadow touches the arc at another point, *B*. Bisect the arc *AB* at *N*. Draw *SN*, and it will be the meridian."

"For greater accuracy, describe several arcs before hand, mark the point in which each of them is touched by the shadow, bisect each and adopt the average of all. The shadow will be better defined, if a piece of tin with a hole through it be placed at the top of the staff, as a bright spot will thus be substituted for the less definite shadow; nor need the staff be vertical, if from its summit a plumb line be dropped to the ground, and the point which this strikes be adopted as the center of the arcs."

This method is strictly correct, June 21st and December 21st; on March 21st, if the observations are made within two hours of noon, the line thus determined is about 2½′ west of a true meridian, on September 21st, same amount to the east, and proportional for intermediate dates.

This is a very simple method, can be applied at a convenient hour, and with moderate care will give results sufficiently accurate for the best compass work Experience of the writer's students shows that a meridian can be determined within 2 minutes by making three or four pairs of observations and taking the mean.

METHOD BY ELONGATION OF POLARIS.—The Pole Star is about 1 degree 20 minutes from the pole of the heavens, and describes a circle about it once in a little less than 24 hours. The star then apparently moves from the meridian for nearly 6 hours, and then returns to the meridian; when at its greatest angular distance from the meridian, east or west, it is said to be at its greatest eastern or western elongation. One of the very best methods of determining the meridian is by observing Polaris at elongation; when the star is in this position, it seems only to move up and down, and neither to the right nor left, consequently the conditions are such as not only to allow an accurate observation but also to give time to repeat the observation.

The angle, or azimuth of elongation, will vary with the latitude, and also with the year, owing to a change in the position of the star. Within the United States it varies from 1½ degrees to 2 degrees. Tables are often given which show the azimuth of elongation, but they are too voluminous to be quoted here; besides it takes only a moment to compute it. The formula is

$$\text{sine of azimuth} = \frac{\text{sine of Polar distance}}{\text{cosine of latitude}}$$

The polar distance of Polaris is 1 degree 17 minutes 57 seconds for January 1, 1886, and decreases 19 seconds per year. A change of 20 seconds in the polar distance of Polaris will make only about 0.4 seconds in the angle of elongation, and a difference of 1 degree in the latitude in the southern part of the United States will make only about 0.8 seconds difference in the azimuth, and in the extreme northern part about 2.4 seconds; therefore it will not be difficult to compute the azimuth of elongation as accurately as even a transit will read.

The Polar distance of Polaris for any year can be determined sufficiently accurately for many years to come by applying the above annual variation; or it could doubtless be obtained by sending an addressed postal card to the Naval Observatory, Washington, D. C.

To make the observation, arrange the plumb line and other apparatus as in the Alioth-Mizar Method; a little before the time of elongation, mark a point, by a pin, knife, etc., in line with Polaris and the plumb line. If the star departs from the plumb line move the point in the opposite way, and keep moving one way as the star goes the other, until the star attains its greatest elongation, when it will continue behind the plumb-line for several minutes; then it will recede from the line in the direction contrary to its motion before it becomes stationary.

Tables showing the times of elongation are often given, but at best they are voluminous and require a correction for railroad time, and an interpolation for the latitude, day of the month, year, and year of the quadriennium; it is better to determine the time directly by an inspection of the heavens. Remember that Polaris is on the opposite side of the Pole from the Great Dipper, and that when the line joining Polaris and Mizar passes through the *east* point on the horizon that Polaris is a little *past* elongation; also when the same line passes through the *west* point, Polaris has *not* quite *arrived at* elongation.

The transit can be used in making the observations instead of the plumb line, the only difficulty will be in illuminating the cross-hairs; sometimes of a clear moon-light night the cross-hairs can be seen without artificial illumination. To make the observation, the vertical hair is kept on the star by using the tangent screw to the horizontal circle until the star seems to have stopped moving sidewise; the telescope is then turned down, and a point in line marked on a fence, etc., by a light seen through a small hole in a board. The instrument should then be reversed in altitude and azimuth and another observation be made; the mean of the two is independent of instrumental errors, particularly collimation and inclination of horizontal axis.

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CLUBBING ARRANGEMENTS.

1886.

The "subscription season" for the most popular American Magazines is close at hand, and inquiries as to our proposed clubbing arrangements are being made. We beg leave to announce, therefore, that on and after JANUARY 1, 1886, the subscription price of ENGINEERING NEWS will be $5.00 per year; until that date the price and clubbing rates with other publications will remain as given below.

We are now planning such improvements in ENGINEERING NEWS, and negotiating for special work to be done during the coming year, as will cost double any possible increase of income from subscriptions; the long notice of change which we here give enables nearly, if not all, present subscribers to renew at present rates. We intend eventually to publish a class journal which will acknowledge no superior in the world, and we feel so confident of the support of our present patrons that we have no hesitation in venturing on the greatly increased expense necessary to carry out our programme.

If an English engineering journal, carrying fifty pages of advertisements and twenty four of reading matter sells for $10, why may not an American journal of equal merit sell for at least half as much.

In order to accommodate such of our subscribers as may wish to subscribe for other periodicals, we offer he following terms until January 1, 1886: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00 and the following at the additional prices given:

	Net. Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Bazar	3.25	4.00
Harper's Young People (weekly)	1.65	2.00
Popular Science Monthly	4.25	5.00
St. Nicholas Magazine	2.55	3.00
North American Review	4.10	5.00
Cassell's Magazine of Art	m 3.00	3.50
Cassell's Family Magazine	m 1.25	1.50

The Century Magazine commences its year with the November Number; Harper's Magazine commences with the December Number. Subscribers should renew these Magazines in October and November.

TO SUBSCRIBERS.

The date of expiration of subscriptions is given on the printed address-label attached to each copy of this paper, and is, we trust, a sufficient notice to all parties proposing to renew for the ensuing year.

As illustrative of the exceedingly onerous duties of the Commission of the New Croton Aqueduct the following instance is given: An Assistant Engineer on the Aqueduct owns a horse, the Commission supplies the fodder; the manure was sold for $10, and now the question arises, To whom does the $10 belong? We have not learned the decision of the Commission but we feel assured that it was made after the most careful discussion of the principles involved in the precedent established.

THE newspapers of Philadelphia have again taken up the much discussed question of the improvement of its streets, sewers and water supply. Whether this action is due to the near advent of its new city charter, in answer to the strictures of the press in other cities, or merely from force of habit, we cannot say; but that the public works mentioned, especially the streets, want improvement, no one will deny.

With 93 per cent. of its one thousand miles of streets, paved with irregular cobble-stones, laid on loamy gravel without sand, Philadelphia can never expect any approach to cleanliness or comfort in that direction. Street-cleaning is an expensive farce as practiced at present over the bulk of that city's surface; and we can not entirely blame the contractors for the evils complained of. Cobble-stone paving, with its ruts and generally irregular surface, does not lend itself readily to any system of cleaning within the bounds of reasonable outlay. So we should say that better paving and plenty of it is one of their most pressing needs, as many other proposed reforms are based upon the condition of the streets.

The sewerage is also bad, being a jumble of faulty design and lack of system, partly inherited from outlying independent districts, since consolidated under one municipal government. Water-pipes of two and three inches diameter are also no longer to be depended upon as the only source of supply in districts filled with valuable merchandise and liable to conflagration.

Verily, Philadelphia needs reform in her public works, and she will want money in her purse even to make a beginning.

THE last number of the *Sanitary Engineer* contains an excellent description of the excavation and final blowing up of Flood Rock, written by Lieut. G. McC. Derby, the engineer officer in charge of that important work for the last few years.

We are very glad to see this detail from the pen of one of the few engineers in possession of all the data. Many points are made clear that before needed further light to fully understand all the bearings of the case, and the exact figures of quantities, cost, time, etc., from an official source, are most desirable.

The high cost of doing the work of excavation, as compared with ordinary contract work, is in a great measure explained by the unreliability of the soundings, necessitating great caution, the government system of eight hours of labor as constituting a day's work, and the uncertainty of government appropriations to such an extent that in "only two years in ten" could the whole plant be worked, though the pumping, superintendence, etc., ran on as a constant factor of expense.

The comparison of results made by Lieut. Derby between the Hallet's Point explosion, of 1876, and that at Flood Rock is interesting. The total cost of the final blast at Hallet's Point was $81,092.24; at Flood Rock, it was only $106,509.93, though the blast was 5.6 times as large; this was due mainly to the different system adopted for firing the charge. The cost of mining a cubic yard of rock at Flood Rock was 34¾ per cent. less than at Hallet's Point; and the total cost of the work done on Flood Rock amounts to $2.99 per cubic yard of the total amount of rock broken, or $5.66 less than the cost of breaking Hallet's Point. This apparent gain, however, will be greatly offset by the proportionately larger amount of dredging to be done at Flood Rock. This dredging was let, in last October, for $3.19 per *ton* for 30,000 tons, the contractor to do his own surface-blasting; the first dredging contract at Hallet's Point was $2.40 and $2.29, but the government had to do the blasting; the third contract at Hallet's Point, under the same conditions as at Flood Rock, was for $3.39, or twenty cents per yard more.

The exact figures of quantities, as given by Lieut. Derby, are as follows: Pounds of rackarock put in drill holes, 240,399; of dynamite, 42,331; total 282,730 pounds. There were 11,789 drill-holes in the roof, and 772 in the pillars, amounting to 113,102 lineal feet. The total amount of rock to be broken by the final blast was 270,717 cubic yards, covering an area of nine acres.

The rackarock used consisted of 79 parts of finely ground chlorate of potash and 21 parts of dinitro-benzole. All the loading in the mine was done by a gang of twenty picked men, who worked from eight to twelve hours per day from July 30th to October 9th; 42,528 cartridges were used. The average charge per hole was 22.5 pounds: the quantity being based on 0.79 pounds of dynamite No. 1 to each cubic yard of rock and every 7000 pounds of water overhead, amounting to 1.04 pounds per cubic yard of rock broken.

Dangerous Railroad Bridges.

An editorial in the New York *Sun* of November 25th, under the above caption, says:

"There is a very disagreeable suggestiveness in the testimony of the Chief Engineer of the Phœnix Bridge Company in the Philadelphia suit to annul the lease of the Central Railroad of New Jersey to the Reading Railroad Company.

"When the lease was made, about two years ago, the witness examined the bridges on the Central. That at Bound Brook was then subjected in portions to a strain three times as great as could be borne with safety. The tension bolts of the bridge at Middlebrook had to endure a strain of 22,000 pounds per square inch, while the maximum prescribed by engineering science is 10,000 pounds. Furthermore, he said the bridge over the Pennsylvania Railroad tracks at Newark was so unsafe that its collapse at any moment would have been no surprise to him.

"The dangers thus mentioned no longer exist, as the structures in question have been renewed or repaired; but there is something startling in the fact that the bridges on one of the best known railway lines in the country, forming a much travelled route between our largest cities, should have been so inadequately constructed. Are there any other railroads, held out to the public as well built and perfectly equipped, which are thus furnished with these death traps for travellers within the short space of one hundred miles?

"The names of the railroad men who were responsible for such a condition of things ought to be made known, so that people might avoid, so far as possible, all lines of travel with the management of which they have anything to do."

While the condition of things referred to by the Chief Engineer of the Phœnix Bridge Co., is, no doubt, greatly to be deprecated, still it is doubtful whether the remedy proposed by the *Sun* would be effective. When the average American citizen sets out upon a journey he does not stop to inquire into the reputation of the men who manage the roads over which he is about to travel, nor to question the condition of the bridges he must cross. And even if a railroad has been pronounced unsafe by a competent authority he will still prefer to take the chances of disaster to his particular train rather than take a longer but safer route to his destination. The average American will travel by the shortest and quickest line even if it be attended with a little more risk than another, and the publication of the names of the managers of an unsafe road, or the builders of a weak bridge would be of little or no account as a public safeguard.

The necessity of some kind of supervision over railway bridges has long been felt and many plans proposed to promote the safety of those structures. After the Ashtabula disaster the American Society of Civil Engineers discussed the question at length, but no plan of action could be agreed upon, and the subject was dropped. The States of Ohio and New York are, it is believed, the only ones in which any movement has been made in this direction. In the former State all railroad structures are examined every summer by one of three inspectors appointed for that purpose by the Railroad Commissioner, and the results of such inspection form a leading feature in the annual report of the Commissioner. In New York an inspector is permanently employed by the Railroad Commissioners, and a minute examination of every railroad in the State made at least once every year. But the New York Commissioners go further than merely to look after the physical condition of railroad bridges. Some time ago the railroads of the State were directed to furnish the Commissioners with plans and strain sheets of all bridges within the State limits, in response to which an immense amount of valuable information has been filed at the Commissioners' office at Albany. A bridge engineer, Mr. Charles F. Stowell, has been at work for more than a year under the direction of the Commissioners, examining these plans and checking the strain sheets. The work has been completed for about three-fourths of the roads in the State, and the result shows that the condition of things formerly existing on the Central Railroad of New Jersey was by no means peculiar to that road. The Commissioners' investigations have brought to light a great many weak spots and still more have been discovered and corrected by the railroad officials themselves when they came to compute the strains on their bridges, which in many instances had never before been done.

When the work is completed it is the intention of the New York Board to publish the results of their investigation in full showing in detail all the features to which objection has been made and the means taken to remedy the same, together with a strain and section sheet of every truss bridge in the State; the whole forming a unique and valuable contribution to this branch of engineering literature.

The New York plan of promoting the safety of travellers over railroad bridges is certainly more feasible and effective than that proposed by the *Sun*, and the example thus set should be followed by all other States. The very fact of such investigation being made under competent direction would have a powerful effect upon the improvement of all existing structures, as it would attract the attention of the railway officials themselves to many antiquated bridges throughout the country that seem to have been forgotten and which do duty rather from "force of habit" than from any inherent virtue of scientific construction.

While such a State supervision would be a wholesome check on old bridges, some further ruling is required to insure the building of all new structures according to the best accepted modern practice. The submission of the plans for all proposed structures to the inspection of a State Engineer, for approval or rejection, would seem to be theoretically the simplest way out of the difficulty. But practically we fear that such a plan would work harm rather than good. The position would be a political one; the official probably appointed by the Railroad Commissioners of the State. Now the trouble lies in the fact that this commission is very rarely, if ever, competent to select an engineer fitted in all respects to act in the delicate position such a bridge umpire would occupy. The State would not pay a salary that would attract any of the comparatively few olden and experienced bridge experts within its borders, and the position would ultimately fall either to an engineer who stood well in political circles, and had little else to recommend him for the office; or to a really well educated young engineer who was fully able to handle the mathematics of his duty, but still lacked that experience and judgment in details and adaptations of design to end in view that only long and varied practice can give him. Neither of these last named men would be fitted to pass final judgment upon all plans submitted; and the creation of an office which could not be properly filled, thanks to the unwritten law of politics and to State "economy," would be unfortunate.

England has some such government supervision in its "Board of Trade Rules;" but both English engineers and the English press charge that the enforcement of these rules retards progress in bridge construction especially, by imposing conditions of stress and load that conform neither with modern materials nor practice. The Rules were once good enough but they are out of date; and this would soon be the trouble with any cast-iron regulations fixed by law; we now advance in scientific construction and the improvement of materials and their manipulation at a pace too fast for the average law-maker.

We believe, however, that good could be gained and better future work secured by making it compulsory with the builder of each new bridge to file in a proper office at the State Capitol a full set of plans, details, strain-sheets and specifications of such structure. In this day of rapid duplication the expense would be light, and the moral effect would be that the designer, knowing his work was on record, and was open to inspection and criticism by other bridge builders, would be more careful and certain of the merits of the plan he submitted. The railroad company employing the designer would be likewise more cautious, and perhaps more willing to pay for competent agents, when they realized the fact that the work of that agent was a matter of public record against them, and that they would be held responsible for any blunders there brought to light in case of accident. In connection with the filing of plans, etc., it might also be well to have a State inspecting engineer, whose duty it would be to watch existing structures and, perhaps, check any attempt at a presentation of false plans; the latter contingency is however a very remote one.

"Accidents" on the New Croton Aqueduct.

Ten men killed in three installments in a little more than a week is a fearful record for any work, and it is time that some other body than a stupid Coroner's jury paid attention to this fact. Five men were killed in Shaft No 3 on Monday of this week and two more in adjoining shafts on the next day, while the death of three men had already been recorded for the week before.

The shaft in which the accident of Monday happened is 385 feet deep; instead of a regularly constructed cage, with proper guides and safety appliances to transport men and material up and down this shaft, an iron bucket was still being used, such as is ordinarily employed in shaft sinking. To prevent the bucket from striking the sides of the shaft in its long descent, a wooden cross-head running in timber guides was strung loosely upon the hoisting rope and was supposed to go down with the bucket until the cross-head struck supports near the top of the tunnel and there rested. On Monday morning while sending down five men of the day shift, this heavy cross-head, weighing some hundreds of pounds and wet with its ascent through the dripping shaft, froze fast in the grooves of the guide, during the twenty-five minutes that it was stationary at the top of the shaft, and when the signal was given, the bucket passed down without it, the rope running freely through the cross-head; none of the men around noticed this fact, but after the bucket had descended the shaft some distance, the vibration of the rope shook the frozen timber loose and it fell, struck the bucket attachment, broke it, or the rope, and the bucket and men were precipitated to the bottom with the fatal results mentioned.

The Coroner's jury complacently render the stereotyped verdict of "came to their death by an accident of their own carelessness and negligence," and this is about all the obituary the victims are likely to receive from that fatal neighorhood.

But was the so-called "accident" due to the negligence of the men who lost their lives? We think not. Five men standing on the rim of an iron bucket and sinking to the bottom of a wet 385 feet shaft in one minute time, have something else to do than to watch out for affairs at the top of the shaft, whatever influence conditions there might have upon their own safety. The negligence was elsewhere than in the bucket; in the first place the loose cross-head was a very faulty device for the purpose intended, and one that has in a very short time cost eight human lives. Then the top-man, whose duty it was to see that all was right about the shaft-head, was away from his responsible post at the critical moment. These being the conditions as reported, the stupid jurymen should have applied their charge of "carelessness and negligence" to the living, rather than to the dead.

The daily work about a tunnel and its shafts is always dangerous; but if chances are not taken and the dangers not discounted, the actual loss of human life can very generally be provided against. We know of works, quite as important in numbers of men employed and quite as dangerous by reason of natural conditions, where *no* lives were lost at all in a term of years; and we know of many others where such loss was due only to unavoidable accident, such as human agency could not well guard against. But in these works referred to, the ignorant or confiding workman was not expected to take care of himself with the penalty of having his death charged to his individual neglect. All the precautions that careful masters could provide, or long experience in such matters could suggest, were put between the laborer and possible dangers to life or limb.

The contractors on the Aqueduct are experienced men, long tried in similar work, and they are fully able to appreciate the fact that something is going wrong in their present management, otherwise this heavy loss of life at close intervals could not occur. In our own opinion, the majority of the "accidents" are the immediate results of an attempt to rush "progress" in the tunnel; and, under the lash of low prices, to make this progress as cheaply as possible, regardless of all risks. We hear much of men crushed by loose rock falling from the roof, which means that time is not afforded to detect dangerous points and to remove or to support them before men are put to work beneath. For this unwise, reckless haste there is no legitimate excuse, for give an efficient foreman the time requisite, and he will, for his own sake, as well as that of his men see that the roof, of all things, is safe.

If undue rivalry, personal considerations, or the press of necessity prevent the contractor from taking the proper precautions to guard his employés, then it is time the Aqueduct Commission stepped in and exercised some authority in that direction. We do not know that they can interfere, under the strict interpretation of existing contracts, so far as the workmen are concerned, but their direct

agents, the engineering staff, are likewise in great danger, and they certainly can demand protection for them. As we understand them, the duties of the Commission are administrative; to see that ways and means are provided to carry on the work, to encourage discipline and check just such disasters as the "accidents" of the past on this work. But instead of attending to this, their legitimate duty, they seem to be meddling with the engineering, a matter they do not understand, encouraging outside opposition to their own engineers, and, in some cases at least, backing subordinates of the engineering staff, or pet contractors against their official superiors. Such a policy pursued to the end is about the best we know of to disorganize the work and make the Commission a very expensive and unnecessary luxury to the citizens of New York. Let them now, for a change, pay a little attention to this accident problem.

American *vs.* English Practice.

Elsewhere this week we publish a communication from a well-known Architect and Civil Engineer of this city in reply to our article on the above subject.

We are surprised that our correspondent's long and varied experience in both countries should have failed to show him that the American engineer saves labor and material by altering his designs, evading an obstacle if possible, or adopting means and machinery to meet the requirements; as is instanced by the speedy introduction of the truck on our engines and its application to our rolling stock generally, thus reducing the rolling friction and making the same amount of coal nearly as productive in efficient traction over our sharp curves and heavy grades, as on the more costly roads of England.

No one would contend that Englishmen at half the wages would spend three times the money in moving a given amount of earth and rock, or if we employed the same patterns for bridges and locomotives, we could send out a better article for 20 per cent. less money. Nor is this a matter of education in the scholastic sense of the term.

We think our correspondent, besides entirely misapprehending the salient features governing the engineering of both countries, has also misapprehended the force and environing circumstances of some of the data he refers to.

The railroads in the Argentine Republic are generally supposed to be built on the Pampas, plains nearly as level as the sea. Nor do we see where ballast could be found for the roads.

In vol. 56, Inst. C. E., page 83, Hungarian roads are divided into two classes: those of the second class are said to cost from £5,300 to £7,800 per mile; it is not there stated, however, that they were built by English engineers.

Of the South Australian roads we learn in vol. 57, Inst. C. E., that 406 miles cost on an average £6,207, sixty-nine miles of this was 5 feet 3 inches gauge, the rest 3 feet 6 inches, of fifty-two and one-half miles costing £3,623 per mile it is noted, "level country, 35 pound rail, very little traffic, engines weighing twelve tons."

The New Zealand lines are all 3 feet 6 inches gauge, as are those of Queensland. These may be in every respect first-class roads, but generally a narrow gauge road is projected with the idea of cheapness. The figures quoted for comparison with the cost of our roads, (which is according to Poor, measured by the amount of their stocks and indebtedness) are often, as reading the context will show, the first cost of the road as it leaves the engineers' hands. Mr. Heaman's paper on the Irish roads shows that some of them were without terminals. The work on the Bolan Pass Railroad was very good; 134 miles of track were laid in 101 consecutive days and the last sixty-two miles were laid in 31 days; but if Mr. Ker is right that the limit of the carrying power is 35 tons per trip, four or five years after it was completed, we wonder what the road was before it was ballasted.

It is difficult to establish the *cost* of a railroad; its indebtedness in stock bonds and floating debts is often known with more or less exactness. In this country these items are apt to be governed more by the supposed earning power of the roads than by their cost, and in making a comparison of the costs of roads in different countries the habits of financiers, as well as the topography, should be noted. Poor's Manual gives the following for the cost of road and equipment per mile of completed road, and the interest and dividends per cent. of stock, bonds and debt.

	1882.	1883.	1884.
Cost	$52,726	$55,461	$55,329
Interest and dividends	$3,65	$3,68	$3,52

In the English Board of Trade Report for the year ending December 31, 1881, we find that the mileage has increased at the rate of 1.3 per cent and the capital at the rate of 2.4, and the interest and dividends were for the years 1879, '80 and '81, at the rate of 4.17, 4.46 and 4.41 per cent., capital being more carefully protected there than here, and the people paying for it in higher passenger and freight rates. No Board of Trade Report for 1883 or '84 is at hand, and the relation between capital and dividends in England can not be traced through the present financial depression. Poor's Manual asserts that the 4000 miles built last year cost from $15,000 to $20,000 per mile against $30,000 for 1883, thus reflecting in a marked degree the depression in the stock market.

In giving the cost of English roads as $180,000 per mile, it is probable a mistake has been made, as Mr. Dorsey in his paper read before the American Society of Civil Engineers at Deer Park, last June, gives it as $202,227 for all the roads in the United Kingdom, which includes Ireland. The Board of Trade Report cited above gives the capital for the 12,807 miles in England and Wales as $616,437,449, this, at $4.88 per Pound Ster., equals $234,888 per mile. The total stock and debt on the Pennsylvania Railroad, 751.11 miles of main line, is $152,365,903, which makes the cost $202,854 per mile. The total track, however, is 1707.75 miles. The New York Central's main line is 441.75 miles long, its total track is 2021.57 miles, of which 529.55 miles are sidings.

The Erie railroad has 429 miles of main line and 1,155 miles of track.

It is asserted by our correspondent that the Pennsylvania, exceptional as it is, is no better than the English roads. Capt. Douglas Galton who examined it carefully, thought it better than any English road, and as far as ease of riding goes, everyone who has had opportunity to ride over it and English roads, will agree with Galton.

The Pennsylvania road reports its main line and branches 1,313.53 miles together; this is equipped with 795 locomotives that make a freight and passenger mileage of 22,892,666, or 28.793 miles for each. The Board of Trade Report for 1881 gives the length of road in England and Wales 12,807 miles. Locomotives 11,474, mileage 208,517,549 = 18.173 miles each, or $63\frac{1}{10}$ per cent. of that on the Pennsylvania. The New York Central with 655 engines made a freight and passenger mileage of 16,840,017, or a mileage per engine of 27,236.

Mr. Dorsey in the paper quoted above asserts that the average English train carries 71 tons of freight against 126, and 43 passengers against 45.5 on American trains, he using the term "English" for all roads in the United Kingdom.

The service done on several roads in the two countries is tabulated by Mr. Dorsey, as follows:

Name of Railroads.	*Mileage per Mile of Single Track.*	
ENGLAND.	Passengers.	Tons.
North Eastern	137,000	455,138
Midland	181,272	542,714
London & North-western	233,777	473,912
London, Chatham & Dover	634,036	195,906
London, Brighton & South Coast	547,328	192,778
Great Western	190,111	304,703
Average	320,587	356,525
UNITED STATES.		
Boston & Albany	272,642	609,680
Boston & Providence	492,863	194,772
New York, New Haven & Hartford	516,694	314,359
New York Central & Hudson River	182,680	927,973
New York, Lake Erie & Western	114,982	1,246,913
Pennsylvania, Pennsylvania Division.	130,235	1,594,898
Average	285,016	809,767

The above American roads were selected with a view to a comparison throughout as having fully as bad grades as the English roads. The charges on the Pennsylvania road were (Poor) 2.44 cents per passenger mile and 0.819 cents per ton mile. The average charges on English roads were (Dorsey) passengers 2.33 cents, freight 2 cents per ton mile.

Mr. Dorsey makes "The average cost of repairs and renewals of locomotives on fourteen railroads in the United Kingdom, cost 7.8 per cent. of the total operating expenses against 5.7 per cent., the average on eight American railroads, or, say, one third less."

The average cost of maintenance of way was 17.8 per cent. of the total operating expenses on the fourteen English roads, against 21.6, say 4 per cent. more, on the eight American. He gives the average total percentage of fuel, wages of engine drivers and firemen; repairs and renewals of locomotives to operating expenses for five English roads, 25, for five American roads 23.7 per cent.

Fox in the paper referred to by our correspondent (read in 1874) before the decrease in freight rates arrives at somewhat similar figures, viz:

	Penna. R. R.	Ry's of U. K.
	s. d.	*s. d.*
Gross receipts per ton mile	5 6¼	5 10
Expenditures per train-mile		
Maintenance of works	8¾	7¼
Locomotive power	11¼	11

It should be noted that the cost of labor in the United Kingdom was only 60 to 70 per cent. of that in this country, and the price of raw materials was not against England.

I. Lowthian Bell, in the course of some remarks on Capt. Galton's paper read before the Institute of Civil Engineers, says "Having traveled many thousands of miles upon American railways, either from the shape of the carriages, or from the character of the springs, or from some other circumstance he had never traveled more easily."

The *some other circumstance* was the superiority of American road-beds in elasticity, alignment, and surface.

The "Lake Poets" did not like their climate in November, and many Americans can not be convinced that it is often as beautiful a month as October. The English, who praise everything English, contend for the solidity of their railroad construction, and Americans who see masonry platforms at stations where we would use wood; massive cast-iron girders of short span topped with a brick wall for roadway crossings, where we would have used a truss of single span; and the immense and crooked masonry viaduct which nearly bankrupted the London Chatham and Dover, endorse the contention. But a solidity of construction that results in less mileage of locomotives and inferior loads, with an equal if not superior cost in those items that depend on the excellence of road bed, will not commend itself to American engineers, and the sooner English engineers fully understand that engineering is not only "controling the great powers of nature" but controling them with a strict regard to the financial results to be obtained, the better it will be for England and the world.

New Croton Aqueduct.

At the stated meeting of the Commission on Nov. 18th, the Committee on Construction recommended as follows upon the manner of passing Gould's Swamp on the line of the aqueduct:—That the plan of a syphon tunnel be adopted and that a supplementary agreement be made for its construction; as to the best method of clearing this tunnel of water, the Chief Engineer is instructed to prepare plans and estimates for both a pumping plant and an adit to the Hudson River.

The Commission also adopted a resolution having for its purpose the adoption by contractors of such rules and regulations as may tend to insure the safety of the foremen, laborers, etc., engaged on this work. The Comptroller of New York was requested to raise the further sum of $2,000,000 upon bonds of the City of New York to defray the necessary and lawful expenses of the Commission.

At the meeting of Nov. 25th, Mr. Clarence A. Kelsey presented for Mr. O. B. Potter and others a tabulated statement concerning the Quaker Bridge Dam; other statements followed on the same subject. At the request of some of the objectors, the Chief Engineer was requested to prepare such a general specification of the proposed Quaker Bridge Dam as could enable competent experts to make from it an approximate estimate of cost. It was also ordered that form of contract, specifications etc. be submitted to the Commission for doing the work from the east side of Harlem River to 135th street.

The Storm King Bridge over the Hudson River.

The New England and South Western R. R. Co. was incorporated on the 22nd of last April to build a road connecting the New York and New England, and the N. Y. L. E. & W. R. R's with a bridge over the Hudson River between Breakneck and Storm King Mountains. This line will make an all rail short route between the New England States and the coal fields of Pennsylvania and cotton fields of the South. The Hudson River bridge will be a cantilever structure, 235 feet above high water mark, with two spans of 700 feet each over the channel. The plans for the bridge are completed and the line located west of the Hudson River, while surveys are still in progress in Putnam Co. Connection will be made with the Harlem and New York City and Northern roads and the coal depot for the East established at Harlem River instead of New Jersey. The bridging of the river was authorized by Chap. 582, laws of 1880 of the State of New York.

The contract for the whole road has been let to the Phœnix Bridge Co., of Phœnixville, Pa., who are to complete the work in two years. They will receive as compensation 25,000 shares of stock, par value $2,500,000, and $6,000,000 first mortgage bonds bearing 6 per cent. interest. The road is stocked for $3,000,000, and bonded for $6,000,000, stock and bonds being deposited with the Central Trust Co. of New York to be paid the contractors as the work progresses.

The officers of the railroad company are: President, Chauncey Vibbard, Vice-President, Jas. W. Husted, Secretary, Chas. H. Swan, Treasurer, Wm. P. Rockwell, Engineer, Wm. V. Smith. Office No. 1 Broadway, New York.

The Railroads of Switzerland.

From the report for the year 1883, issued by the Federal Department of Roads and Railways, we extract the following particulars.

The roads are operated by private companies and are divided into three classes, viz.:—1. Standard gauge roads of ordinary construction; 2. Lines of special construction; 3. Cable railroads.

1. These lines, of 4 feet 8½ inches gauge, are operated by locomotives on the usual method, and comprise 2,410.480 kilometres (1,494 miles) of single, and 257.744 kilometres (160 miles) of double track, making a total of 2,668.224 kilometres (1,654 miles), at a cost for construction of from about $26,400 to $237,500 (St. Gothard) per mile.

2. These lines are subdivided as follows: (*a*) 4 feet 8½ inches gauge, maximum grade 7 per cent., worked by ordinary locomotives. (*b*) 4 feet 8½ inch gauge, maximum grades 9 to 25 per cent., rack rail system with locomotives. (*c*) 3 feet 3⅜ inches (metre) gauge, maximum grades 3.5 to 5 per cent., worked by ordinary locomotives. (*d*) 2 feet 6 in. gauge, maximum grade 3 per cent., worked by ordinary locomotives. These roads comprise 79.744 kilometres (49.5 miles) of single, and 2.046 kilometres (1.25 miles) of double track, making a total of 81.790 kilometres (50.75 miles). The cost for construction ranged from about $2,500 to $178,000 per mile.

3. This class has also subdivisions; (*a*) 4 feet 8½ inches gauge; maximum grade 11.6 per cent. (*b*) 3 feet 3⅜ inches (metre) gauge; maximum grade 32 to 57 per cent. The total length of the three lines on this system is 3.387 kilometres (2 miles), and the cost for construction and equipment from $175,000 to $560,000 per mile.

Including 57.5 kilometres (35.6 miles) of lines on Swiss territory operated by foreign companies, but not including 9 kilometres (5.5 miles) of lines on foreign territory operated by Swiss companies, there were, at the end of 1883, 2,801.795 kilometres (1,737 miles) in operation, of which 49.739 kilometres (31 miles) were opened during that year.

There were in all 615 locomotives, and the rolling-stock comprised 1,800 passenger cars, and 8,989 freight cars.

There were also in 1883, 25.327 kilometres (15.75 miles) of horse railroads.

Surburban Rapid Transit.

The work which has been steadily progressing for four years past, looking towards the establishment of a complete system of rapid transit in that part of New York City which lies north of the Harlem River, by means of the Suburban Rapid Transit Company, has reached a point where vigorous prosecution of the construction of the whole system is both desirable and practicable. Under the judicious management of the President, Mr. S. R. Filley, the numerous obstacles in the way have been successfully overcome, and the first mile of the road is so nearly ready to go into operation, that the Manhattan Railway Company is constructing as rapidly as it can, the transfer station, etc., connecting tracks with the 2nd Avenue Elevated road, south of the Harlem River, and has also taken up a franchise which was obtained a year or two ago by opponents of the Suburban Company, and which it was thought might at some time cause trouble, but is by this action brought into harmony with the Suburban.

The work so far completed by the Suburban Rapid Transit Company is of a superior character, and has been constructed according to the plans and under the control of their Chie Engineer, Mr. J. J. R. Croes, C. E. The iron superstructure of the draw bridge across the Harlem River, and the four track elevated structure across the freight yard of the New Haven Railroad, were designed by Theodore Cooper, C. E., the consulting engineer on iron structures.

The bridge is 32 feet above high water, and the passenger trains of the New Haven Branch Railroad to New Rochelle will run over it, two of the tracks on the approach being on an ascending grade from the level of that road half a mile north of the river. The other two tracks proceed northwardly through Morrisania, through property purchased by the Company, on plate girders supported on brick piers and crossing all streets overhead. The contractors for the bridge superstructure were the New Jersey Iron & Steel Co.; for the iron viaduct, Alden & Lassig, and for the iron girders on the main line, the Phœnix Bridge Co. The contract of the last named firm will not be completed for three months, but trains will be run over part of the line early in January.

The cars have been built by the Pullman Palace Car Co., and the locomotives which are 33 per cent. heavier than those of the Manhattan Railway, have been furnished by the Baldwin Locomotive Works. Mr. Croes' specifications requiring a test of the engine before acceptance, a trial trip was made a few days ago on the Reading Railroad, the locomotive drawing a train of loaded coal cars weighing 200 tons up grades of 36 to 40 feet to the mile at a speed of 15 miles an hour, with ease.

Natural Gas in Illinois.

A recent news item in one of the Chicago papers, to the effect that the natural gas wells near Tolono, Ills., were failing, has been so widely copied, and has been the cause of so much speculation as to the permanency of all such wells, and particularly those near Pittsburg, that the following particulars obtained by our special correspondent on the ground about the Illinois gas fields will be of interest.

The gas wells of Illinois may be divided into two classes which are widely separated in location and distinct in source of supply. In this article they will be referred to as the Champaign county and the Litchfield field.

CHAMPAIGN COUNTY FIELD.—Champaign county, situated on both sides of the Illinois Central Railroad, about 128 miles south of Chicago, is a rich and slightly rolling prairie, traversed by two very small streams; the surface is diversified by a few natural groves. The geological structure is that common to the prairies of the State, which is so simple and well known as to need no description.

It seems that gas was first discovered in 1854, five miles north—northwest of Urbana, while digging for water, at a depth of 20 feet. There was enough gas to make a flame full size of the well and 10 or 12 feet high. Owing to a superstitious fear of the monster, the well was filled up, and even the dwelling house for which the well was being dug was moved to what was thought to be a safe distance. The next gas well was discovered accidentally, while digging for water, two and one-half miles south of Champaign, in August 1873, at a depth of 65 feet. The pressure was estimated at 10 pounds per square inch. The flow was through an inch and a quarter pipe. The gas was used as fuel in the farm house. The well filled with water and had to be pumped out every two or three months. The flow decreased gradually for two years when it failed entirely, owing almost certainly to the filling of the tube with sand and mud. The evidence on this point is quite conclusive, but is too long to be related here. However, the following item is worth recording.

Soon after the opening of the above well, a 12 inch hole was bored for water on an adjoining farm, in which an equally strong vein of gas was reached at 70 feet. The special feature to be noted in connection with this hole is, that sand boiled up in the tube, and filled it to a height of 30 feet the first night, the sand being "packed in the tube almost like hardpan." The well was abandoned.

After the failure of the first well as above, a second hole was drilled for gas; the flow was less than before, but the well still continues to furnish a little gas. Before the well was tubed a large quantity of water and "bushels of fine sand" were thrown out. The pipe of

this well terminated in the ordinary screen used in driven wells—a cylinder about a foot long made of finely perforated copper. The most plausible explanation of the decreased flow is that fine sand, and possibly mud, accumulated against the screen. The well has had little or no attention since being drilled.

The particulars of these two wells are given in full because they were the first, and because they are fairly typical of some dozen or more others since bored in the neighborhood. Generally the gas has been discovered while boring for water, and in only about a dozen cases has an attempt been made to utilize the gas. Usually a well is not more than sufficient to warm a small house, and frequently is capable of running only a single stove.

There are two other wells which need special mention. They are situated north of Urbana in the immediate vicinity of the well in which gas was discovered in 1854, as recorded above. These wells are remarkable as giving very much the largest supply of any wells in the county, perhaps more than all the others combined. The pressure is about the same in both, 25 pounds to the square inch, through a 2¼ inch pipe open at the lower end. One is 80 and the other 90 feet deep. One has been running two years, the gas being used in comparatively large quantities to warm a farmhouse; although not tested with a gauge, the supply seems not to have decreased, although it blew for forty-eight hours before being piped, and large quanties are often blown off in showing the well to strangers. A company has just been incorporated to furnish gas from this well for heating and lighting in Urbana. The second well has only recently been drilled. At first it tested 12 pounds, but now shows 25 pounds through a 2¼ inch pipe.

The experience in boring for water shows that equally strong wells can be found almost anywhere in this immediate vicinity. One well of about 25 pounds pressure was found at a depth of 45 feet; but was drowned out by water from a lower level, which was encountered in deepening the hole to increase the gas. The water not only drowned this well, but saturated the gas bearing stratum for a considerable distance; this vein has not been recovered, although ten holes were sunk for that purpose.

So far as can be learned, gas has not been found except as below, in any considerable quantities, more than four miles north of Champaign, nor south of Tolono, nine miles south of Champaign; all gas wells are confined to a strip not much over one mile west nor two miles east of the I. C. R. R. The above limits fail as to one small gas well about four miles west of Champaign. Rumor has it that gas has been discovered in DeWitt county, forty miles west, but nothing definite can be learned concerning it. The papers have recently announced the formation of a stock company to prospect for gas in that county. A small vein of non-combustible gas was discovered about eighteen miles northwest of Champaign.

Within the last few days the papers have announced the finding of gas at Mendota, about one hundred miles northwest of Champaign, at a depth of 70 feet. This suggests the idea that possibly gas from this stratum can be obtained at intermediate points between Champaign and Mendota; geologists state that an anticlinal passes through the state from northwest to southwest, the crest not being far from this line. If this be true, wells in this region will tap the accumulated supply for the lower portions of the gas producing stratum.

The chief, if not the sole, gas bearing stratum, is a dirt bed from 3 to 12 feet thick at a depth of 70 to 90 feet; this layer contains leaves, sticks and old trunks of trees, together with a fine

It is highly probable that the gas is due to decomposition of the organic matter in this dirt bed. The gas is odorless, colorless, has but little illuminating power and apparently a high heating effect. It has been analysed and pronounced to be nearly pure marsh gas. The dirt bed is found wherever borings are made; but is not equally porous nor of the same thickness, which may account for the finding of gas in some localities and not in others. In some places the gas has apparently leaked into a higher stratum through fissures in the roof of the lower gas vein. It may be worth while to mention that no coal has been discovered within 35 miles of Champaign, although a number of trial holes have been sunk.

With no intention of giving an opinion as to the permanency of the supply, the writer concludes after personal investigation that the failure of the present wells is not due to an exhaustion of the supply, but to an accumulation of fine sand or water, or both, at the lower end of the tube. In this connection it must be borne in mind that all the wells blew fine sand and water when opened, that all are lined with small pipe, and that in some of the wells the tubing terminates with a fine screen. Cleaning out never fails to increase the supply. The whole thing has been done almost by accident, with crude implements in a very primitive way. Inferences drawn from the Champaign county wells are in every way inapplicable to the wells in and around Pittsburg.

LITCHFIELD DISTRICT.—Litchfield is situated in Montgomery county, Illinois, about 80 miles northeast of St. Louis. Petroleum in comparatively small quantities was found a mile and a half southeast of there, some five years ago, at a depth of about 700 feet while boring for coal. The boundaries of the oil field have not been determined except on the north; the existing wells are included in 40 or 50 acres.

June 7, 1883, Van Vleck Brothers, while boring for oil, struck a strong flow of gas at 643 feet in a layer of white pebble sand one foot thick. The owners claim that when first struck the pressure in this well was 560 pounds per square inch. The boring was continued to 800 feet, where a large vein of salt-water was encountered, which finally drowned out the gas. The water could only partially be stopped off; but by pumping the salt-water out, this well for the past two years has furnished fuel for four 20 horse-power boilers.

October 21, 1885, the same firm struck another gas well 725 feet southeast of the old one, in which the pressure is 96 pounds. The tube is 5½ inches in diameter. They expect to drill four more this winter. They have the contract to light the streets of Litchfield, and already have laid 4 miles of mains.

The gas is found in a layer of coarse sand just above the oil rock. "The formation is very much like that in McKean and Forrest counties, Penn., except that the sand is white like that in Butler county, Penn."

The strata have a dip to the northwest, in which direction large quantities of salt-water are encountered. Of the 17 oil wells, gas, to amount to anything, has been found in only three. The gas is colorless with a strong odor.

OTHER WELLS FOR COMPARISON.—The largest supply of natural gas is found in the neighborhood of Pittsburg. In a general way the gas wells are in a narrow belt extending fifteen to twenty miles on either side of that city, at an angle of about 45 degrees in a northeast and southwest direction.

For some unknown reason the depths of most of the wells are intentionally withheld. One in the Murraysville, West Virginia, district is said to be 1,337 feet deep. Another one, whose location is not known, is reported to be 1,940 feet deep. The highest pressures that the writer has seen reported are 350, 300, 250 and 125 pounds per square inch; pressures of 75 to 100 pounds are common. The number of wells is not known, but can be judged of approximately from the fact that two years ago, which was almost the beginning of the development of the natural gas supply, 150 companies had been organized in Pennsylvania to supply natural gas for fuel and light. Natural gas has been used in a small way in the Pittsburg district since 1840. The total product is beyond all computation; a single well furnishing 30,000,000 cubic feet per day, which is a half more than enough to supply New York City for the same time. An immense quantity of gas goes to waste in all the fields. The gas has a large amount of paraffine in it, which accumulates in pores of the gas rock and stops the flow.

Exhalations of combustible gas have been frequently met with in other countries, although nowhere in quantity comparable with the prodigious outflow from the gas wells near Pittsburg. The gas wells of New Cumberland, West Virginia, have supplied gas for more than twenty years for the manufacture of brick. The East Liverpool, Ohio, wells have been burning for twenty-five years and are still productive.

Natural gas has also been found at Freeport, Pennsylvania; at Creighton, Ohio, at West Bloomfield, Olean and Fredonia, N. Y., (at the last place it has been running forty yrs); at Petrolia, Canada; and the papers have recently announced the incorporation of two natural gas companies at Springfield, Ohio. Considerable quantities of gas frequently issue from the "mud-lumps" which form in the Mississippi near its mouth.

Natural gas has been flowing for a great number of years at various points around the Caspian Sea. In Hungary it issues from fissures, and has long been used in lighting the mines. In China gas is obtained in large quantities from salt-well borings, and is used in boiling down the brine and for illuminating and heating purposes. Some of these borings are 3,900 feet deep and yield gas under great pressure; they are said to have been running 4,000 years.

At Erie, Pennsylvania, so many wells have been drilled that the supply has been exhausted. At Beaver Falls, Pennsylvania, natural gas has been used for six years in cutlery works, but lately the gas has failed, presumably on account of the flow being cut off by parffine accumulating in the pores of the rock, or by an incrustation of lime and magnesia, as the wells have never been cleaned out since they have been drilled. In the oil region a gas well was considered rather as a curse than as a blessing, and as most of the wells produce gas as well as oil, and so many were drilled to the gas-bearing strata that it soon exhausted the supply.

Natural gas, next to hydrogen, is the most powerful fuel known. It contains no sulphur and therefore makes better iron, steel, glass, etc., than coal.

PERSONAL.

FRANCIS M. LEONARD, a civil engineer, 39 years of age, died suddenly on the 6th, at his residence, No. 154 East Thirtieth street, New York.

A MEETING of civil engineers was held on December 2, in the office of the County Surveyor, of San Antonio, Texas. The purpose of this meeting was to organize an association of their profession throughout the State. This was a preliminary meeting before steps are taken to organize the proposed association.

WILLIAM H. VANDERBILT, the railroad king and many times millionaire, died suddenly from apoplexy at his residence in New York, on Tuesday, December 8th. Mr. Vanderbilt was born May 8, 1821, at New Brunswick, N. J.; inherited the chief part of the vast

wealth of his father, on January 4, 1877, and by judicious management succeeded, according to current rumor, in doubling the Commodore's $100,000,000. By virtue of his wide-spreading interests he was a power in the railway and financial circles of this country.

A Bureau of Public Works Wanted.

CLEVELAND, Ohio, Dec. 6.—The Civil Engineers' Conference, which was in session here several days past, closed to-day, and a ma majority of the delegates left for home. Delegates were much elated at the success of the convention and the amount of work accomplished. It was decided to create a national committee to be known as the Civil Engineers' Committee on National Public Works. The delegates of the convention will serve on the committee until replaced by members elected from societies. The conference adopted a resolution asking Congress to establish a Bureau of Public Works, the basis of the organization of this bureau to be made the subject of study and report by a board appointed by the President of the United States.

St. Louis Engineers' Club.

At the meeting at St. Louis, Nov. 18, 1885, Wm. B. Knight, C. E., was elected member, and the Executive Committee recommended that the meetings be held on the first and third Wednesdays of each month during the session, which was adopted.

The Secretary then read a programme for the winter:

Dec. 2.—C. M. Woodward, "Theory of Ammonia Refrigerators."
Dec. 16.—Thos. J. Whitman, "History of the St. Louis Water Works."
Jan. 6.—J. A. Seddon, "Cross Sections of Uniform Flow in River Physics."
Jan. 20.—P. M. Brunel, "The Use of Hydraulic Cements."
Feb. 3.—Chas. C. Brown.
Feb. 17.—Chas. W. Melcher, "The Theory of the Sustaining Power of an Air Jet."
March 3.—Robt. E. McMath, "The Future Drainage of St. Louis."
March 17.—A. P. Man, "The Determination of Openings for Bridges and Culverts."
April 7.—W. Paul Gerhard, "Disposal of Household Waste."
April 21.—Geo. H. Pegram.
May 5.—S. Bent Russel, "Water Supply for Fire Service."
May 19.—W. H. Allderdice.
June 2.—Report of Committee on Smoke Prevention.

Prof. J. B. Johnson read a paper on "The Solar Azimuths by Transit Attachments and Base Line Measurements by the Steel Tape," General discussion followed.

THOS. D. MILLER, *Secretary.*

WATER

NATURAL gas has been obtained at Ottawa and Berea, O.

THE Ellendale, Dak., artesian well will be 1,1000 feet deep.

THE artesian bore at Kimball, Dakota, is down 900 feet and as dry as a chestnut.

THE Weymouth, Mass., water-works were successfully tested on the 4th.

MATTOON, ILLS., expects to turn water into the new works in a few days.

Sealed proposals for building a main sewer will be received by the City Clerk of Springfield, O., until the 22d. inst.

STAMFORD, CONN., has voted to issue bonds for $100,000 to pay for a complete system of sewerage, and the work will be commenced immediately.

MITCHELL, DAK., has an "8,000-barrels-a day" artesian well, and the City Council now wants a system of water-works for fire protection.

The artesian well being bored at Belden's silk mill at Northampton seems likely to reach a depth of half a mile. Already the distance is approaching 1,800 feet, with no signs of water.

TUSCOLA, ILLS., coal prospectors are once more down 764 feet. The work will be continued to 1,000 feet if coal is not found before. Urbana has just commenced boring. Bement has a 500 foot hole and no coal.

DANVILLE, ILLS., abandoned gas at $1.80 per 1,000 feet for electricity, which has been found cheaper. It costs $5,900 per year to light the city.

THE pumping engines of the Ann Arbor, Mich., water-works, were started on an experimental trip, Nov. 30, by the constructing engineer for Goodhue & Birnie, Mr. W. S. Boulton, of Massachusetts. The engine is a Knowles duplex pump, with a capacity of over 1,500,000 gallons daily. The engine was found to work evenly, and to meet the entire approval of Mr. Boulton.

THE supply main across the Kinnickinnic at Milwaukee has been broken by an anchor of a dredging scow, and a part of the city is being supplied with water through hose pipes stretched over the river. The well-known diver Breymann, of the firm of Thatcher & Breymann, of Toledo, O., has been sent for to repair the break.

OMAHA SEWERAGE.—The projected sewerage system is just now a topic of considerable interest to those who have property in the city, and are truly anxious for the welfare of the town. The plans of Chester B. Davis have been adopted, and the city attorney is now said to be preparing an ordinance for legalizing a proposition to vote $100,000 for sewerage purposes.

CHATTANOOGA, Tenn., Dec. 4.—This morning shortly after 12 o'clock, Charles Anderson, who with his grandfather Jesse R. Cravens, was sinking a shaft on Lookout Mountain to discover a stream of water, struck the same after going sixty feet through solid rock. The underground stream has a fall of nearly 300 feet. Pipes are to be laid to the city and the inhabitants furnished with pure spring water.—Nashville *American.*

JERSEY CITY WATER WORKS.—Engineers Bacot and Ward have expressed the opinion that unless a new pump is purchased, the entire upper portion of the city would suffer a water famine, should a break in the pipe now in use occur. About sixty feet of the stand pipe at Belleville is rotten, and it is to be repaired at a cost of not over $2,500, and the works are to be painted.

THE special water commission of Albany, N. Y., have recommended that the city be supplied with 10,000,000 gallons of water daily by a system of driven wells located on the Van Rensselaer flats opposite Pleasure Island. The "Drive Well" men are now well represented in that city.

A PIECE of 1-inch steam pipe in the service of the New York Steam Heating Company, got to leaking and was dug up. The pipe was completely corroded through for 12 inches of its length, and fell in pieces while being removed. "Coal ashes and cinders were the cause of that trouble," said the engineer in charge. "A pipe soon gives out when it is buried in cinder.

DENVER, Colo., is to be illuminated by electricity at a cost of $28 per lamp, against $35, the lowest offer of the gas company. There are 450 lamps. The system is the Edison. The cost of the plant $20,000. The contractors are the ColoradoE lectric Co.; W. B. Rundle, manager. The Denver municipal electric lighting system will comprehend twenty circuits, with twenty-seven lamps to a circuit when each circuit has its full complement. The lamp will be placed on the present gaslight posts extended up some four feet whence the light will be thrown a greater distance than if nearer the ground.

BRAVER FALLS, Pa., Dec. 6.—At 1 o'clock this afternoon the natural gas was shut off from this place to make connection with a new main at Rochester. At 9 o'clock this evening it was not turned on again. In the meantime the greatest discomfort has been experienced and much suffering caused. The weather is bitterly cold. It has been snowing all day and the wind blowing a regular blizzard. Many families went to bed supperless and to keep warm. Others abandoned their houses for those of their neighbors more fortunate in the use of coal. Guests forsook the hotels, and restaurants using the old-fashioned fuel were taxed up to their utmost capacity to feed hotel guests and private families. Churches held no evening services, and manufacturers running night-turn shut down. Every body grumbled, men swore and children cried. Another such mishap this winter and the "fuel of the future" will be abandoned.

Minneapolis Pipe Bids, Opened December 3rd.

Names of Bidders.	906½ tons. 6-inch	964½ tons. 8-inch	199½ tons. 10-inch	733½ tons. 12-inch	506½ tons. 16-inch	781 3-10 tons. 24-inch	Special. Castings.
Dennis Long & Co., Chicago	$31.48	$31.24	$30.69	$30.43	$30.24	$30.00	$70.00
Shickle, Harrison & Howard, St. Louis	26.70	28.70	27.70	27.70	27.70	26.70	.02 7-10
Lake Shore Foundry, Cleveland, Ohio	28.70	28.55	28.40	28.25	28.10	27.95	
Cincinnati and Newport Iron and Pipe Co.	30.58	30.58	30.58	30.58	30.58	30.58	60.00
R. D. Wood & Co., Philadelphia	31.80	31.80	31.80	31.80	31.80	31.80	
Warren Foundry and Machine Co., New York	29.80	29.80	29.00	29.00	27.80	27.50	50.00
A. H. McNeal, Burlington, N. J.	30.00	30.00	30.00	30.00	30.00	30.00	
North Star Iron Works, Minneapolis	.....	.....	.....	.....	.....	.....	.02 23-100
Emaus Iron Works, Philadelphia	30.25	30.25	30.25	.....	.....	.....	.02 25-100
Lockwood, Upton & Co., Minneapolis	.....	.....	.....	.....	.....	.....	.02 23-100

CAPE MAY, N. J., expects to be forced to bring an additional supply of water from the mainland, at an estimated cost of $25,000.

THE Cambridge, Massachusetts, Aldermen have referred the following to the committee on finance:—

That a city debt to the amount of $75,000 be created for the extension of the water-works, and that bonds be issued, payable in twenty years, at a rate of interest not exceeding 4 per cent.; that a city debt to the amount of $200,000 be created for the Stony Brook construction of water-works, and that twenty years' bonds be issued, with interest not exceeding 4 per cent.

THE Standard Oil Company has a scheme under way to pipe natural gas for heating and illuminating purposes in Buffalo. The plan is to lay a large trunk line from the Venango district to Corry and from thence to Buffalo. At Corry there will be placed the pumping machinery necessary to force the gas to its destination. The machinery, it is said, will be constructed on the principle of the great Worthington duplex pumps used by the National Transit Company for pumping oil, modified in such a manner as to adapt them to their new uses.

ILLINOIS COAL MINES.—Colonel John S. Lord, secretary of the state bureau of labor statistics, has prepared a supplemental report of the coal producing interests of Illinois for the year 1885. His statistical table shows that there are now employed in the mines in this state 25,446 persons. The amount of capital employed is $9,886,950, and the number of mines of all kinds, 786. There are 46 more openings reported this year than last, though 9 mines have been abandoned. The net increase over the aggregate of last year is 37. The number of counties now producing is 49. Notwithstanding the increase in the number of mines, the total out-put has been less than in either of the two preceding years. The tonnage for 1884 was 10,101,005; that for 1885 is 9,791,874, being 309,131 tons less than last year. There have been 30 persons killed outright during the year, and 176 disabled; 20 men killed from falling of roof or rock, 2 from gas, 1 from premature discharge, 7 from falling down shafts, 2 from falling cages, 2 from pit cars, 1 from boiler explosion, 3 struck by timbers, 1 drowned in swamp.

This year represents about 500 car loads of pipe of different sizes, or over 5,000 tons, the estimated cost of which, together with the special castings required, hydrants, valves, and distribution of the same will be about $148,300. The cost of laying the twenty-four miles of new mains is approximately estimated at $50,688, making a total expenditure next year on account of the contemplated extensions in the water system amounting to nearly $200,000. Fortunately, the resources of the board are such that this great expenditure can be provided for without embarrassment or difficulty, from the sale of bonds authorized, the taxes levied upon benefitted property, and the water rentals, which will amount this year to about $100,000.

The bid of the Lake Shore Foundry company of Cleveland was accompanied by a telegram ordering 55 cents to be added to each figure named in their bid.

A telegram was subsequently received from Mr. McNeal offering to make his bid on all sizes $30.79 per ton, in consequence of favorable freight arrangements which he had just perfected.

Upon footing up the average of each bid received it was found that Messrs. Shickle, Harrison & Howard, of St. Louis, were the lowest, at $27.95 per ton, which will make their contract good for $116,020.60 the largest made by any single pipe firm during the present year. Mr. Howard was present at the meeting, and may remain to bid on other work to be performed during the coming season, and if successful, the above figure will be materially increased. The average price of the pipe furnished this year by Dennis Long & Co., of Louisville was $27.63 per ton, or 35 cents less than that of Shickle, Harrison & Howard. On motion of Commissioner Foote all the bids were referred to the committee on construction with instruction to report at a special meeting of the board to be held 2 o'clock this afternoon. The mayor suggested that arrangements should be made for the flexible iron pipe to be laid across the river, and read a letter from MacRitchie & Nichols, of Chicago, offering to furnish and lay the pipe, if desired by the board. The communication was referred to the committee on extensions and the engineer to make such arrangements as they may deem advantageous, to report at a future meeting of the board.—St. Paul *Pioneer Press.*

THE Larned Water Works Company, of Larned, Kan., has been incorporated to build water works for the city of Larned.

THE Cleveland Rolling Mill Co. have obtained natural gas at a depth of 3,162 feet, but will go deeper in hopes of securing a better supply.

THE Galesburg, Ills., Gas Co., are putting in a plant to light that place by electricity. The Thompson and Huston, and Brooklyn Electric Construction Cos. lights will be used.

AN exciting contest is in progress at Vincennes, Ind., having for its object the annulment of the contract with the gas companies, and the substitution of electric lights.

THE following is among the latest petitions to be presented to the Massachusetts Legislature:—

Of the Dedham Water Company and the Jamaica Pond Aqueduct Company for authority to sell water to each other.

ARTESIAN WELLS.—Daniel Dull, contractor, is putting down artesian wells at Perth Amboy, N. J., and Westchester, N. Y., 12 inches and 10 inches diameter respectively. In drilling for water recently at Binghampton, N. Y., this contractor struck a vein of natural gas, which it is intended to utilize for fuel and light.

DES MOINES, IOWA, has constructed thirteen miles of sewers of varying sizes in the last five years. The total cost was $254,774.74. The sewers range in size from 12 inches to 60 inches in diameter, and cost from $1.35, the lowest, to $8.40, being the highest price paid for the construction of any sewer in the city. The total cost of paving up to date was $412,095.

A MEMBER of the Water Committee, of Mont Clair, N. J., said that the real estate transactions had been closed, and that Verona Lake was the proposed source of supply. The detailed report is out; the plan is to pump the water from Verona lake to a reservoir on the mountain, from whence the town would have the water by gravity.

ARTICLES of incorporation of the Morrison, Col., Water Company, have been filed. Capital stock $5,000. The operations of the company will be carried on in Jefferson county, with the principal office at Morrison. The incorporators are George Morrison, Peter Christenson and William S. Smith.

THE natural gas craze extends all through central Ohio. Two companies have been formed at Springfield with a capital of $2,500,000. Manufacturers in towns are combining to sink wells. Companies have been formed at Hamilton, Xenia, Dayton, Columbus and other towns.

LINCOLN, ILLS., is discussing the advisability of constructing water-works of a daily capacity of 1,000,000 gallons, several surveys have been made, and a proposition has been received from a Watertown, N. Y., firm. Two sources of supply are proposed; one a coal shaft, and the other by damming a small creek in which case a filtering gallery will be necessary.

THE first trapped water-closet on record is that invented by Alexander Cumming, and patented in 1775; the basin is bowl-shaped, and the water is delivered into the lower part instead of at the top, while the soil-pipe is recurved about twelve or eighteen inches below the basin, so as to constantly retain a quantity of water sufficient to cut off all communication of stench from below. In 1777 another water-closet was patented by Lemuel Prosser, but does not appear to have been adopted; in 1778 the well-known valve-closet of Bramah was patented. The expensive character of Bramah's arrangement led later to the introduction of the pan-closet and D-trap, which are now being removed wherever this can be done.—*Sanitary World.*

NEWS OF THE WEEK.

Contracting.

Court House Bids.—Bart Donovan's bid of $74,600 for the brick work of the superstructure of the court house at Pittsburg, Pa., has been accepted.

The Pennsylvania Coal and Iron Company has purchased 19,000 acres of coal and iron lands in Arkansas, the veins of which run into the Indian Territory.

Cross Ties.—The Texas Trunk Railroad Co., wants bids for 18,000 first-class cross ties, to be furnished on its line of road between Dallas and Kemp; for specifications address R. H. IRVINE, Gen'l Supt., Dallas, Texas.

Church Contract.—The contract at Chippensburg, Pa., for the erection of the new Presbyterian Church has been awarded to George Rice, of Philadelphia, for $25,300.

Coal Shaft.—Dr. Newell will begin sinking a shaft to develope a vein of coal, at Ness City, Kan., within a few days. The depth will be 220 feet. The coal is lignite.

Court House.—It will require 285 tons of iron to construct the roof of the new court house at Minneapolis, Minn., and the contract has been awarded to Haugh, Ketcham & Co., at the bid of $75,847.60.

Bridge.—Bids for building the superstructure of the Sixth avenue bridge, Milwaukee, Wis., will be received by the board of public works on December 18th, the contract to be completed April 5, 1886.

Building Contract.—The contract for rebuilding the Southern Illinois Normal University, at Carbondale, Ill., was awarded October 21st to Parry & Deal, of Peoria, Ill., at their bid of $117,337. The building to be completed October 1, 1886.

The Bad Axe Extension Contracts.—M. Lalley, of Detroit, has been awarded the contracts for building the extension of the Saginaw, Tuscola & Huron Railroad to Bad Axe and the work commenced on the 1st. The route has been surveyed and staked, contract for the ties, rails and spikes have been awarded and it is expected to have the trains running from East Saginaw to Bad Axe by the Fourth of July next.

Soldiers and Sailors Home.—After a great deal of canvassing, the commissioners have selected Quincy as the location of the Soldiers and Sailor's Home. The commission has made its formal report to that effect to the Governor. It will be the business of the Governor within ten days, to appoint a board of three to take charge of the site and provide for the erection of the buildings.

Contractors' Exchange.—The contractors and builders of Grand Rapids, Mich., have perfected an organization to be known as the Contractors' and Builders Exchange. The following are the officers and directors: President, George H. Davidson; vice president, J. H. Hosken; secretary, J. D. Boland; corresponding secretary, Chas. W. Davidson; treasurer, L. C. Davidson; directors for two years, James Curtiss, E. Maunder; for one year, F. Eckert and C. W. Davidson.—Grand Rapids *Daily Times.*

Street Improvement in San Antonio.—At no time in the history of San Antonio has the work on the streets been done so thoroughly. At first the ground is plowed up to the proper depth, when the grade is established according to the grade of the City Engineer, under his assistant, Mr. E. W. Swart. The new steam roller, for the use of which the contractor pays $8.00 a day, then rolls the ground thoroughly, when the first layer of large rock is put down carefully by hand, and all the openings well filled with sprawls, making a perfect foundation. This part of the work is under the superintendence of Mr. Manual Serna. There are about sixty wagon loads of rock used daily. When the ground is put on the foundation it will be again rolled by the steam roller. This, undoubtedly, will be the most thorough street work ever performed in this city; and no good reason is now seen that it will not be of a very permanent character. So far, the steam roller has given perfect satisfaction.—San Antonio *Light.*

Suits with Contractors.—OTTAWA, Dec. 4.—Litigation involving large amounts of money has been commenced between the Pacific Railway and some of their contractors. One firm of contractors—Conmee & McLennan—claim a balance due on their contract of about $200,000, and on October 5, began an action to recover the amount. The railway company not only denies its liability, but says it has overpaid the contractors about $600,000, and has begun an action to recover back from them that amount, the writ issuing on October 30. The fight so far has been as to which action is to be proceeded with, and as to whether there is or is not to be a jury. On Wednesday, Chancellor Boyd gave judgment, holding that the railway company's action is the one that should proceed and that there should be no jury. This action is brought to set aside progress certificates which the railway company says were fraudulently and collusively obtained by the contractors from the officers of the company, to restrain them from receiving a final certificate and for the repayment of what has been overpaid.

Chancellor Boyd was of the opinion that this was an equitable cause of action but expressed the opinion that the prima facie aspect of the case upon the progress certificates was in the contractors' favor, and it rested upon the railway company to displace it by showing fraud.

Building Project.—The Central Safety Deposit Company has leased from the city of Chicago the lot on the southeast corner of La Salle and Adams streets for 99 years, free of taxes, at an annual rent of $35 000, and upon this is to be erected a building costing $1,000,000, and probably the largest in the city. The $1,000,000 has all been subscribed. About three-quarters of the capital is from Chicago, and the rest from eastern cities. The directors are N. B. Ream, W. E. Hale, E. C. Waller, D. H. Burnham, and Owen F. Addis. Mr. Addis represents $588,000 of the capital, mostly for residents of this city. The lot is 177 by 188 feet, and the structure to be erected upon it will be 10 stories high, have about 700 rooms, and hold ordinarily about 2,500 persons. The materials will be granite, brick and terra cotta, and the building will be used for safe deposit vaults, offices and stores. The plan for the first floor provides for a great arcade, comprising 60 stores, which can be thrown into one system. By the terms of the lease the building, which is to be finished by May 1, 1887, will revert to the city when the lease runs out. The city bought the lot in 1852 for $8,750. A big building erected upon it was known as the "Rookery," and was used as a City Hall for some years after the fire.

Railroads, Bridges and Canals.

Mission Ridge R. R.—The preliminary survey for this Tennessee line is now in progress.

Tunnel.—It is proposed to consolidate the Albany railroad stations. A tunnel has been suggested by Superintendent Toucey of the N. Y. Central R. R.

The Oregon Railway and Navigation Company announces that its Columbia and Paloure branch is extended and in operation to Moscow, Idaho.

Wyalusing Bridge.—Bids for the superstructure of the Susquehanna bridge at Wyalusing vary from $18,700 to $29,400.

St. Louis Cable R. R.—Mr. Dennis, chief engineer of the cable street railroad in St. Louis, Mo., thinks the line will be in operation by the 1st of January.

Railroad Wanted.—Benton, Montana, offers $100,000 towards building a connection with the Canadian Pacific.

The Dakota Midland have decided to complete thirty miles of the road early in the spring west of Campbell, and make arrangements to pay the floating debt.

The Brooklyn Elevated Railroad Company is preparing a plan for further extensions of their line, and will probably lay the matter before Mayor Low and the Common Council during this week.

The Mount Pleasant and Seaview City R. R. is seeking a charter. It proposes to build a line through Mount Pleasant to Sullivan's Island, connecting by ferry with Charleston, S. C.

Bridge Draw.—The U. S. engineers have ordered that the draw in the wagon bridge across the Wabash, at Attica, Ind., should be restored to enable boats to pass up and down the river. This is in accordance with an act making appropriations for the construction, repair and preservation of certain works on rivers and harbors, passed by Congress on July 5, 1884.

Iron & Steel Works.—The ground for the iron and steel works, Uniontown, Pa., has been surveyed and staked out for the Pennsylvania Construction Company's shops, and work will be rapidly prosecuted. E. M. Butz, one of the stockholders, and W. T. Manning, have located the switches for the Baltimore & Ohio.

Pontoon Bridge.—The Burlington & Northern, will, it is reported, build a pontoon bridge at Dubuque. Most of the bridge can be built upon piling. This will do away with the necessity of an expensive tunnel to reach the east shore. The estimated cost of the new bridge is $100,000.

Surveys for a New Road.—AKRON, OHIO, Dec. 5.—Surveyors under Engineer George Ford, yesterday began running a line for a new railroad from here to Chicago Junction, which is to complete the Baltimore & Ohio line from Pittsburg to Chicago, shortening the Baltimore & Ohio present route between those points by forty miles. The survey is taken up from the western terminus of the Pittsburg, Cleveland & Toledo Road in the northwestern part of this city.—Nashville *American.*

New R. R.—UNION CITY, TENN., December 1st.—The surveying company started out from here this morning to make a preliminary survey, and estimates from the line of railroad from Pierce Station, on the Chesapeake and Ohio Road to this place, with a view to changing the line of that road so as to pass through Union City, and tap the main line again at East Troy, six miles west of Rives. The enterprise is being vigorously pushed by the solid men of this place, and every assurance is felt that the change will be made, and the consequent completion of the Union City & Tiptonville Road, which will make Union City the most important railway center in West Tennessee. The surveying party is under charge of Col. J. J. Williams, of Jackson, formerly chief engineer of the Mobile & Ohio Railroad.

Chesapeake & Nashville Railway.—The town of Glasgow, Ky., has offered $50,000 and the right of way through Barren county, as an inducement to the C. & N. Ry., to run through the town. The contract for seven iron bridges between Gallatin, Tennessee and Scottsville, Ky., were awarded to the Keystone Bridge Co. of Pittsburg, Pa. Contracts have been let for 90,000 cross ties, and the steel and engines for entire line have been purchased. The contractors are pushing masonry and trestle-work. The Common Council of Nashville have passed to second reading the bill granting the necessary privilege in that city, and upon the completion of the agreement work will be begun from Nashville to Gallatin.

New R. R.—A number of citizens of Northfield, Le Sueur Center and Kasota, Minn., signed articles of incorporation for a railroad from Northfield to Kasota. The preliminary survey will be made at once.

The Hastings, Neb., Street Railway Company, capital $70,000, has filed articles of incorporation with the Secretary of State in Lincoln. The proposed route covers fourteen streets and connects with the B. & M. and St. Joe & Grand Island depots. The incorporators are C. L. and M. L. Alexander.

Railroad Construction in Kansas.—Active preparations have begun at Fort Scott, Kan., looking to the immediate commencement of work on the Kansas, Nebraska and Dakota Railroad. Estimates are being made upon the two bridges in this county, and bids will be let on the 12th of the present month for the grading of thirty miles of the road.

The Black River Falls Lumber and Iron Railway Company filed articles of association with the Secretary of State for Wisconsin. Its object is to construct a line radiating from Black River Falls to Goodyear and Point City. The total distance is forty miles, and the capital stock $1,000,000. Among the incorporators are Congressman Williliam T. Price and J. H. Mills.

Kentucky R. R.—MADISON, IND., December 1st.—Wm. Daggy and A. T. Keightley, of Greencastle, Ind., arrived here to-day and immediately left for Trimble county, where they will survey a line of railroad from Milton to Eminence, Ky. They are in the interest of some road which wishes to bridge the Ohio at this point and connect with the Cumberland and Ohio Railroad at Eminence, Ky.

Change of Gauge.—It is stated that on the authority of one of the directors of the Washington and Waynesburg Railroad that the Pennsylvania Company has obtained control of the line, and will make it a standard gauge road. At a meeting in Waynesburg, Pa., John E. Davidson, of Pittsburg, was elected Treasurer, and J. W. Reimer, Auditor. A movement to extend the line to Blacksville, W. Va., is said to be on foot.

A Long Railroad.—A road has been incorporated to run from Onawa, Iowa, to the Indian Territory. The survey has been made, and the grade found to be easy; bonds have been voted over part of the line, and a charter obtained for a bridge at Decatur, Neb. The southern terminus is to be El Paso, Texas, and if encouragement is given, the road will extend north by way of Cherokee, Spencer, and New Ulm to Minneapolis, Minn.

Kansas Railways.—Within less than a year charters for railways aggregating nearly 3,500 miles have been filed in this state. This will nearly double the mileage of railroad in the state if these be all constructed. As Kansas has not yet passed the period in its growth when it is thought necessary to vote bonds in aid of railroads, most of them will probably be built.

Kansas has had fifty-one railroad charters filed in the statehouse during the last six months.

New Iron Bridge.—Surveyors at O'Keefe gulch, about ten miles west of Missoula, Montana, are making preparations for building masonry for the iron superstructure over the canyon to replace the present wooden bridge. About 200 feet of the west end will be filled thirty feet high with earth. This iron system will be composed of plate girders, thirty feet in length. They will be supported by iron bents, they resting upon solid masonry. The highest point will be 112 feet, and the total length 650 feet. The road proposes to replace four other high wooden trestles with iron structures at an early day.

The B. & O. R. R.—A charter has been issued at the State Department, Harrisburg, Pa., to the Philadelphia, Newtown Square & Chester Railroad Company, the line of which will run from Philadelphia to West Chester, and will be thirty miles in length. The capital stock is $2,500,000, and the following are the officers: president, Thomas M. King, Pittsburg; directors, James B. Washington, Alleghany; John S. McLean, Nelson C. Griswold, B. F. Young, E. D. Smith, Pittsburg; J. V. Patton, Ellentown. Of the shares of stock at $50 each, Mr. King holds 1,300, and Messrs. Washington and McLean 500 each. The gentlemen named above are all connected with the B. & O. Railroad Company, and it is intimated that the new road is part of the scheme to reach New York by a short route.

The Pickering Valley Railroad.—It has been rumored at West Chester, Pa., that the Pickering Valley Railroad is to be abandoned. It extends eleven miles west from Phœnixville, through Schuylkill, East and West Pikeland townships and part way into Upper Uwchlan, where it terminates in a field, this terminal point being called Byers Station. The road cost about $500,000 and has a mortgage and floating debt of about $650,000. Its capital stock is $100,000. It was leased to the Reading Railroad Company in 1871 for twenty-nine years. A short time ago an effort was made to pass it into the hands of the Pennsylvania Railroad Company, who would continue it four miles southwest to strike the East Brandywine and Waynesburg Road at Dorlan's Mills.—Philadelphia *Press*.

First Railroad in Cincinnati.—The well-written and interesting article of Dr. Pearne, appearing in our *Methodist Review* for November, brings vividly to my mind the first railroad and the appearance of the first train of cars in Cincinnati. I think it was in the year 1842. What is now called East Front street was utilized as the road-bed from Deercreek, as it was then called, to a point near where the old McKendree Chapel stood, where it crossed the street and ran along the hillside to the round-house that stood about three-quarters of a mile from the depot at Deercreek. This round-house was sufficiently capacious to hold two locomotives and was supplied with water from a little rill and some springs on East Walnut Hills.

The tramway was prepared by digging into the earth 10 or 12 inches, and placing horizontally heavy oak flitches; then stretching across these ties 6 or 8 inches square; then putting upon the top of these oak streamers probably 20 feet long, and upon these the strap-iron upon which the wheels of the cars ran, the whole forming a compact mass of timber that did fairly well until dislocated and disturbed by frosts and storms.

The first locomotive that ran upon this track was named for one of the first Governors of Ohio, "Governor Morrow," and each of the three passenger cars had a name, the largest and best, "James Madison;" the second, "Little Miami;" while a very small one, with seats arranged for the passengers to sit facing each other, was called "Columbia." This last-named proving too light for railroad travel, was sold as an omnibus to the Ruckers, who used it between Broadway and Sportsman Hall.

The first engineer was named William Vanlew, and his fireman was John Stephens. Vanlew was a devout Christian man, an officer in the McKendree charge, while John Stephens was a member of the United Brethren. What a change since in the general morals of railroad men.

For several months daily trips were made to Milford, a distance of 12 miles, and the freight-cars came loaded chiefly with whiskey from Kugler's and other distilleries along the Little Miami River.—Cincinnati *Enquirer*.

A Narrow Gauge Sensation in Southern Ohio.—A syndicate has been formed, of London (England), Paris (France), German and New York capitalists, whose object is to form and complete a line of three feet gauge railroad, extending from a point on the James River, Virginia, via either this city, Bloomfield, Ind., or Bloomington, Ill., and through Southern Illinois to the Mississippi River. There it is to connect with the Texas and St. Louis Railway to Laredo on the Rio Grande, and then to connect with the Mexican National Railway for the City of Mexico, the distance being 2,900 miles of main line of narrow gauge, of which 1,900 miles are in successful operation, and 1,000 now in process of construction. The syndicate has purchased the Columbus and Maysville Railway. This is a narrow gauge built from Hillsboro to Sardinia on the C. and E. Railway. It was originally intended to build the C. and M. Railroad to Maysville, Ky., via Georgetown, Ohio.

The syndicate last week bought the line with its rolling stock. The people of Georgetown donated the right of way and ties. This syndicate has also secured the right of way between Georgetown, O., and Ripley, the citizens of Ripley having given them ten acres of ground at Ripley for yards. Work has already begun on the line between Sardinia and Georgetown. The syndicate will at once put the line under construction from a point on the Dayton and Southeastern Narrow-gauge at or near Washington Court House, via Hillsboro, Sardinia and Georgetown to Ripley, opposite Maysville, Ky., and operate this line with the trunk line as a part of the system.

As that part of the combination between Cincinnati and Portsmouth has not been formed, and the City of Dayton is anxious to have the division between Bloomfield, Ind., and Ohio run via Dayton, and use the Dayton and Southeastern from that point to Ironton, the question of location has not as yet been settled as to this city and Dayton, being points on the main line.

The syndicate in purchasing the Columbus and Maysville Road see that that line can be utilized to a special advantage, and form a good and valuable extension to the main stem. The Chief Engineer and General Manager of the construction is now in this city, and has taken full control of the C. and M., and has commenced the repairs of that part of the C. and M. now in operation, and will at the earliest moment this winter extend the line to Georgetown and Ripley, having already made all satisfactory arrangement with Georgetown and Ripley for the work.

The completion of this road will give Georgetown two roads (the C., G. and P. Narrow-gauge now being completed to that town) and Ripley its first railroad. It seems this syndicate stole a march on the C., G. and P. in getting right of way and entrance between Georgetown and Ripley, and into the latter. It will give the C. and E. an opening to enter Georgetown and Ripley and by this competition give these towns the benefit of competitive rates.

This movement promises to be an important one and the narrow-gauge road of southern Ohio.—Cincinnati *Commercial Gazette*.

The Chicago, Burlington & Quincy R. R. Company seem ready to take the initative in the war of branch extensions. In addition to the lines contemplated in northwestern Nebraska, two new lines have been determined upon, and the contract already let in the South Platte. The first of these will start from Elwood, which is now the western terminus of the Holdredge branch of of the Kenesaw cut-off.

The Hutchinson, Glencoe and Southern Railway Company has been incorporated for the purpose of constructing a line of railway and a line of telegraph from Hutchinson, Minnesota, in a general easterly direction, with the privilege of connecting with any line of railway in the State of Minnesota at any point, or from Hutchinson via Glencoe, in the direction as above stated. Also from Mankato, via Glencoe, Hutchinson to the north line of the state of Minnesota.

President, Matthew J. Peppard; Vice President, A. H. Reed; Secretary, D. A. Adams, and Treasurer, G. K Gilbert. Directors, Matthew J. Peppard, Warren J. Ives, John Haney, A. H. Reed, G. K. Gilbert, D. A. Adams, G. M. Nelson, W. W. Pendergast, W. T. Bonniwell, Kee Wakefield, and J. B. Bassett.

Cape Cod Canal.—The work on the Cape Cod ship canal has continued during the year, but no section has been completed and no settlement has been made with the contractor since last years' report. The directors of the company, in their report to the railroad commissioners for the year ending September 30, 1885, say that the corporation has received from the contractor, F. A. Lockwood of Boston, pursuant to their contract $10,985.72 which has been expended as follows: Right of way, $652,39; legal expenses, $2500; salaries of officers, $7333.35; rent, care of office and incidentals, $500. There has been no change of officers since the last annual report. The report is signed by W. A. Clark, Jr., Samuel Fessenden, George S. Hall, Richard Shenix, directors.—Boston *Globe*.

The Chester County Road Bought.—Since obtaining the charter for the Philadelphia, Newtown Square and Chester Railroad, which is to terminate at West Chester, the Baltimore and Ohio has abandoned the idea of purchasing the Chester County Road, which runs between the two present old lines from Philadelphia to West Chester, and it has been bought in the interest of the Pennsylvania. The line has never been completed and is only partially graded. It was sold under foreclosure early last summer and was secured by a syndicate for $150,000. The purchasing parties, it is understood, have offered $200,000 for it, and although the negotiations have not yet been concluded, there is but little doubt that the offer will be accepted. Pennsylvania officials declined to either affirm or deny this information, but the foregoing is authorized by a gentleman interested in the deal.—Philadelphia *Press*.

Another Railroad.—FREMONT, NEB., Dec. 2.—At a meeting of the Board of Directors of the Fremont & Central Nebraska Railroad an executive committee consisting of L. D. Richards, E. H. Barnard and J. J. Hawthorne, was appointed to look after the early construction of the road. It is proposed to follow the old survey over into the Maple creek, when they will go west, following the Shell creek, and then north and west into the Loups. The old survey runs more to the northwest, but it will be abandoned and go further south on account of a branch of the Fremont, Elkhorn & Missouri Valley R. R. building from Scribner. The money for the construction of this line is at the command of the company, and it means business.

The Southern Scheme Lags.—A Piqua, O., dispatch says that the proposed connecting link between the Chicago & Atlantic and Cincinnati, Hamilton & Dayton roads, of which Piqua is to be the eastern terminus, and Huntington, Ind., the western, is not booming so much as it was. It was announced early last summer that a trunk line from Chicago to the seaboard was to be created via Huntington, Piqua, Dayton, Ironton, and thence across the Ohio river to a connection with the Chesapeake & Ohio. The only new road required for the proposed trunk line would be that between Piqua and Huntington. Through the summer and fall a great deal of surveying was done around there, and track laying was to have started before this time, but from present information and indications the bottom has gone out of the enterprise, temporarily at least.

Helping a Man to Retire.—When Mr. Jay Gould entered the elevator of the Western Union Building Tuesday morning last week, he bore the appearance of a man in deep meditation, a fact which seemed not to impress the old man in charge of the wire ropes, who broke up his reverie rather rudely:

"Shure, Misther Gould, its meself that congratulates yer retirement from the Strait."

A big hand struck Mr. Gould's shoulder, and his amazement was supreme.

"As for meself," resumed the man at the ropes, "yez can help me to retire too, for I have two bors that is just ready to shtart in life, and yez is the boy to do it for 'em wid $50,000."

Everybody laughed except Mr. Jay Gould, who said, "Let me off at the third floor."

A new man is now in charge of the elevator.

Land and Canal Co.—Articles of incorporation were issued at Springfield, Ill., November 28th, to the Florence Land and Canal Company, at Chicago; capital stock, $1,000,000; to construct an irrigating canal in Pinal county, Arizona Territory; incorporators, Peter Fish, J. T. Young, and F. E. Makul.

Big Suits Against Railroad Contractors.—MONTREAL, December 3rd.—The engineers commissioned by the Canadian Pacific Railway to re-measure the contract sections to the north of Lake Superior, have completed their labors, the result being that the company has overpaid the contractors $1,200,000. Demands have been made to re-imburse this money, which in the case of the smaller sections, have been complied with, but the three larger contractors refuse, and suits to recover the amount have been entered here and at Toronto. Conmee & McLellan are being sued for $5,000,000, R. R. McLellan for $225,000 and James McRae for $200,000.—*Gazette.*

Looking Up New Territory.—FARGO, DAK., December 2.—Governor Marshall and Gen. Bishop, of St. Paul, the parties who recently bought the partly graded Dakota and Great Southern Railroad, came from East to-day in a special car, in company with Messrs. Easton and Myers, leading stockholders of the Milwaukee Road. It was learned that they were on their way to Tower City, the northern terminus of the Great Southern, to examine that route, with a view to commencing its construction in the spring, probably, in the interest of the Milwaukee. It extends from Tower City, on the Northern Pacific, south some 300 miles, to Sioux City, as projected extending through the most fertile and populous portion of the Northwest. It will give North Dakota more direct connection with Chicago and St. Louis.—*Globe Democrat.*

The Memphis, Birmingham and Atlantic Railroad is now an assured thing. This road grew out of the road once known as the Memphis, Selma and Brunswick road, or rather, it is the same corporation. A capital stock of $700,000 has been provided, and the issuance of first mortgage bonds for a like amount, but the sum necessary to complete the road to Birmingham is $4,500,000 and that amount has already been pledged to the new company. James B. Pace, of Richmond, Va., was elected President; T. C. Leake, Vice-President; W. C. Watts, Secretary and Treasurer. A full board of directors were elected. Mr. Pace, the President, is largely interested in the coal fields of Alabama which the new road will traverse. This road will carry to Memphis an article of coal that will come in direct competition with Pittsburg, and it is the purpose of the new company to supply coal at this point to steamboats, factories, etc. It is announced that arrangements have been perfected to extend the Talladega and Coosa Valley Railroad to the coal fields.—*Coal Trade Journal.*

The Arkansas Valley R. R.—LITTLE ROCK, ARK., November 27th.—A very important railroad scheme became public to-day, by which the Arkansas Valley R. R. showed its hand to the extent that it had abandoned the plan of simply running a local road between small points and depending upon a scanty local traffic for its existence. The articles of association, filed this afternoon, tell the whole story. A new company has been organized, known as the Kansas and Arkansas Valley Railway Company. It is to be an extension of the Arkansas Valley route through the Indian Territory into Kansas. It is proposed to connect with the Little Rock and Fort Smith Railway at the town of Van Buren, thence through Crawford county to the line of the Indian Territory near Fort Smith, thence through the Indian Territory northwest to Arkansas City, Kansas. It is also proposed to build a branch to Coffeyville and connect with the Southern Kansas Railway line. The main line is to be 246 miles long and the branch 75 miles. The capital stock of the company is $8,000,000, and the incorporators are Elisha Atkins and F. Gordon Dexter, of Boston, Mass.; E. H. Winchester, Portsmouth, N. H.; R. F. Wilson, New York; Jesse Turner, Sr., Van Buren; John D. Adams, John G. Fletcher, George W. Hughes and Henry Wood, Little Rock; C. W. Huntington, and J. B. Thomas, New York. The Commissioners to open books of subscription are John G. Fletcher, John D. Adams and F. Gordon Dexter. It is proposed to build the line as soon as possible.—*Globe-Democrat.*

The Mexican National Railroad.—The Mexican National Railroad Company has finally arranged through Matheson & Co., of London, to obtain funds to complete the line. The plan is for the present bondholders to relinquish the first mortgage for new bonds to the amount of $7,000,000. This agreement has been signed by seven-eighths of the present bondholders and the new loan has been made. Work will begin within three months. Matheson and Co. are the largest holders of Mexican National bonds.

The report that the company is about to buy the partially completed bridge of the International or Gould Road at Laredo, and the grade thence via Mier to Linares, for $300,000, is not viewed favorably in Texas. The Matamoros and Monterey Railroad is now finished to San Miguel, eighteen miles this side of Camargo. It is known that the National folks are bound to build more road soon, and it is feared that they will take what rails they have at hand and lay them on the purchased grade south from Laredo to Mier, and perhaps thence to Linares, which is in a rich country. This will cut Matamoros off from all her up-river trade, which will then go to Laredo, and Matamoros can have no chance to compete until the company shall complete the gap of thirty-three miles from San Miguel via Camargo to Linares line, fifteen miles above Camargo. This probably will not be done soon. The purchase of the Gould works will, however, be a good thing for the company, and will give them a fine bridge at Laredo at a small cost.—*Globe Democrat.*

Reduction of Wages.—E. P. Reynolds & Co. and D. C. Shephard, the contractors building the Burlington & Northern, have reduced their laborers' wages from $1.50 to $1.25 per day. They also reduced the hours of work from ten to nine hours.

The Barnum Wire Works in Detroit were totally destroyed by fire on the 3d. The building was valued at $112,000, the stock at $50,000, and the machinery at $150,000.

The Barnum Wire Works Company was incorporated in the spring of 1882, with a capital of $160,000, which was subsequently increased to $200,000. Their prosperity seemed unlimited, and in December, 1883, a new company was organized on a broader basis, with a capital of $300,000. The large establishment was built on Wabash avenue, in this city, in the spring of 1884, and branch factories and salesrooms were established at Chicago and Windsor. In July, 1884, a large number of attachments were levied on the works for amounts varying from $5,000 to $25,000, and it was charged that the indebtedness was contracted on fraudulent representations. Eight suits were begun against the company in the Superior Court, and two in the Circuit Court, in consequence of which the company assigned on July 28, 1884, to Abram L. Stebbins, who subsequently became Receiver by order of the court. At the time of the failure the assets were $464,644.06 and the liabilities $349,120.51. Soon after the failure a combination of capitalists bought up the entire indebtedness of the concern at 50 cents on the dollar. Pressing claims were allayed, but the company was not out of trouble. The few who did not go into the syndicate claimee that the receiver conspired to defeat their claims. Suits and counter-suits were commenced in all the local courts, and some of them are now pending here in the Supreme Court. Recently an effort was made to sell the works, but an order from the court stopped the sale.

Market Report of Engineering Materials.

New York, December 10, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles	1.90	@	2.00
Tee	2.25	@	2.35c.
Beams and channels American	3.0c.	@	
Tank	2.	@	2.1c
Shell	2.4c.	@	2.5c
Steel plates, Tank	2¼c.	@	
WROUGHT-IRON PIPE., PITTSBURGH.			
Butt welded, black ....Discount	42½	@	45
" galvanized .... "	32½	@	35
Lap welded black .... "	60	@	62½
" Galvanized .... "	45	@	42½
Boiler tubes	55		
RAILS.			
Steel (large lots at mill)	34.00	@	35.00
Old rails	19.00	@	20.00
Old railsteel	19.00	@	20.00
R R. spikes	2.25	@	2.75
R R, splice-plates	1.75		
R R. Track Bolts Square Nuts	2.75		
Barb-wire fencing, galvanized			4.60
" " painted			3.60
Corrugated iron			
Nails			
Iron, per keg	3.00		
Steel do.	3.10		

METALS.

COPPER.			
Lake Superior	11.12	@	11.35
Other Brands	10.00	@	10.20
LEAD.			
Com. Domestic			4.50
Lead Pipe	.06¾		
Tin-Lined Lead Pipe	.15		
Sheet Lead	.06¾		
ZINC.			
Sheet	5.30	@	5.50

BRICK.

Cargoes afloat)			
Haverstraw .....per M.	$5.75	@	6.25
Fishkill			
Up-River	5.50	@	6.12½
Jerseys	5.25	@	6.00
Long Island			
" pale	2.75	@	3.50
FRONTS.			
Croton, red	11.00	@	14.00
" dark	11.00	@	14.00
" brown	10.00	@	13.00
Philadelphia pressed	24.00	@	25.00
Trenton "	24.00	@	25.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	65.00	@	130.00
" American	85.00	@	120.00
Fire brick	25.00	@	45.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

BAETJER & MEYERSTEIN:			
Hanover Portland	$2.60	@	$2.65
BELLONI & Co.:			
Hemmoor "Crown" brand			2.50
JAMES BRAND:			
K. B. & S	2.55	@	3.00
BROOKS, SHOOBRIDGE & Co.:	2.45	@	2.60
HOWARD FLEMING:			
Gibbs' English Portland, 400 lbs	2.65	@	2.90
K. B. & S. "	2.75	@	2.95
Stettiner, German	2.65	@	2.85
Lagerdorfer, "	2.45	@	2.75
Fieve, A 1, Belgian	2.35	@	2.50
Roman	2.75	@	3.00
Keene's Coarse	4.75	@	5.50
" Fine	7.75	@	8.50
" Superfine	8.50	@	10.00
FISHER, ERSKINE W.:			
Stettin (German) Portland Cement	$2.40	@	2.75
GABRIEL & SCHALL:			
Vorwohler "Lion"	2.65	@	3.10
HUDSON RIVER CEMENT Co. Rosendale			1. 0
JOHNSON & WILSON:			
Saylor's American Portland	2.15	@	2.40
LAWRENCE CEMENT Co.:			
Hoffman Rosendale			
LESLEY & TRINKLE, Philadelphia, Pa.:			
"Giant" Portland	2.30	@	2.40
Improved "Union"	1.25	@	1.50
Union	1.10	@	1.20
MARCIAL & Co.:			
J. B. White & Bros. Coarse	4.50	@	5.00
" Fine	8.00	@	10.00
" Portland	2.45	@	2.85
NEW YORK CEMENT Co.:			
Rosendale			1.20
N. Y. & ROSENDALE CEMENT Co.:			
Rosendale, "Bridge" brand			1.10
SINCLAIR & BABSON:			
Alsen's Portland	2.45	@	2.75
K. B. & S.	2.35	@	2.60
STANDARD CEMENT Co.			
E. THIELE:			
Dyckerhoff	2.90	@	3.25
UNITED STATES CEMENT Co.:			
Windsor	1.00	@	1.10
Standard			1.15
Cable's Portland	2.15	@	2.40
UNION AKRON CEMENT Co.:			
Akron "Star" brand			

ASPHALT.

Prices range per ton	$15.00	@	20.00
According to quantity or brand, and whether taken from vessel or store.			

LIME.

Rockland, common per bbl	1.00		
" finishing	1.20		
State, common	.90		
" finishing	1.10		
Kingston, ground	95	@	1.00
Add 25c. to above figures for yard rates.			

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90	@	0.95
" " No. 2 "	0.75	@	0.80
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " " "	0.75		
Brown stone, Portland, Ct. "	1.00	@	1.30
" Belleville, N. J. "	0.75	@	1.25
Granite, rough	0.60	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00

SLATE.

Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@	20.00
Choice "	65.00	@	70.00
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@	.50
Tally boards, dressed com. "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	20.00	@	22.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2½ × 4 to 4 × 6 in	.16	@	.44
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00	@	40.00
YELLOW PINE, Girders "	25.00	@	30.00
Dressed flooring "	28.00	@	35.00
SHINGLES, Extra shaved pine, 16 in. "			
" sawed 18 in. "	5.75	@	6.00
LATH, Cargo rs "	2.25	@	2.30

PAINT.

Lead, white, American dry per lb	.04¾	@	.05
" " in oil pure "	.05¾	@	.06
English, B. B. in oil "	.08¾	@	.08¾
Red, American "	.05¾	@	.05¾
Litharge "	.05	@	.05½
Venetian red, American "	.01	@	.01¾
Indian red "	.05	@	.10
Vermillion, American lead "	.11	@	.11¾
Paris green "	.15	@	.20
Umber, Amer. raw and powdered per lb.	.01¾	@	.01¾
Drop black, Amer. "	.07	@	.13
" " Eng "	.11	@	.13
Chrome green "	.05	@	20
Oxide zinc, American "	.03¾	@	.04
" French "	.06¾	@	.06¾